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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.


THE GROSS EARNINGS OF 154 RAILWAYS operating 88,560 miles of road for the month of August, 1890, according to statistics collected by the *Financial Chronicle*, are $40,634,120, as compared with $39,052,895 for the corresponding month of 1889, an increase of 4.05%. The per cent. increase is much smaller for August than for any other month of the current year, it being less than one-half that for June, the next smallest. A considerable number of the larger roads show losses. Considering the roads by groups, the Southern roads lead all others in the general favorable character of their earnings. Of the Southwestern roads, the Atchison, Topeka & Santa Fe and the Denver & Rio Grande show large gains as heretofore, and several of the other lines also show improved results. On the other hand, the Chicago, Rock Island & Pacific shows a loss of $165,953, and several of the other lines have losses of greater or less amounts. The Northwestern lines, with one or two minor exceptions, exhibit increases. The Middle Western group shows more decreases than any other. This is attributed largely to the short winter wheat yield, and in the case of the New York Central & Hudson River R. R. and tributary lines to the recent strike.

THE WORKING OF THE ZONE TARIFF in Hungary during the first ten months of its being in force is shown in the table below. Every month shows a great increase of receipts, even during the winter season:

| | Number of travelers. | | Total number of travelers. | | Receipts. Mil. florins. | |
|---|---|---|---|---|---|---|
| | Short distance. | Long distance. | Aug., '89, to May, '90. | Increase upon previous year. | Aug., '89, to May, '90. | Increase. |
| Aug., 1889.. | 533,105 | 559,335 | 1,112,440 | 677,581 | 1.332 | 0.329 |
| Sept., " .. | 595,532 | 550,665 | 1,146,197 | 718,521 | 1.126 | 0.158 |
| Oct., " .. | 587,991 | 477,611 | 1,065,602 | 652,016 | 0.993 | 0.141 |
| Nov., " .. | 567,284 | 407,333 | 971,617 | 629,185 | 0.829 | 0.157 |
| Dec., " .. | 517,727 | 354,436 | 871,163 | 539,282 | 0.733 | 0.085 |
| Jan., 1890.. | 488,017 | 329,938 | 817,955 | 497,844 | 0.669 | 0.081 |
| Feb., " .. | 489,540 | 326,025 | 815,565 | 531,466 | 0.653 | 0.119 |
| March, " .. | 568,390 | 401,947 | 970,337 | 633,546 | 0.754 | 0.130 |
| April, " .. | 639,201 | 470,736 | 1,109,937 | 723,948 | 0.935 | 0 195 |
| May, " .. | 601,065 | 583,292 | 1.184,357 | 806,217 | 0.946 | 0.186 |
| Total.... | 5,697,852 | 4,367,318 | 10,065,170 | 6,409,609 | 8.973 | 1.586 |

During the period referred to, therefore, the number of travelers increased from 3,655 to 10,065 millions, or nearly trebled, while the receipts rose from 7.38 to 8.97 million florins, representing an increase of about 1.5 million, or 21 per cent.

THE CHICAGO ELEVATED TERMINAL RY. CO. has been incorporated, and proposes to solve the grade-crossing question by the construction of a four-track viaduct for the use of the principal railways entering Chicago. At the head of the enterprise is JOS. T. TORRANCE, the builder of the Chicago & Calumet Terminal Ry. The terminus of the road would be at a handsome union passenger station near the center of the city.

The viaduct is to be partly of brick arches and partly of steel girders with a buckle plate floor. The route of the road is still undetermined, but it is proposed to purchase part of the real estate acquired by the Atchison, Topeka & Santa Fe some time ago.

THE WESTINGHOUSE-PULLMAN consolidation, about which some extravagant stories have been told in the daily papers, proves to relate only to a concern for the manufacture of electric street cars. Under the system pursued by competing companies the cars are purchased from one company and the motors from another. It is proposed to erect works at Pullman costing about $500,000, for the manufacture of electric street cars, the motors for which will be furnished by the Westinghouse works at Pittsburg.

STREET CARS FOR SMOKERS are to be tried on the Market St. Cable Ry. in Philadelphia. The company has recently designed a number of open motor cars 18 ft. long intended for the use of lovers of fresh air and tobacco. Taken in connection with the recent proposal of a like nature on the King's County Elevated Ry. in Brooklyn, the innovation seems to point to a condition of affairs in the near future on our systems of city transit similar to that on the London Underground Ry., where every train has a number of smoking compartments.

AN INTERLOCKING SWITCH AND SIGNAL PLANT will be placed in the Jersey City yards of the New York, Lake Erie & Western R. R. by the Johnson Railroad Signal Co. Three towers will be necessary.

THE NORWOOD CAR REPLACER was tested at Cleveland, O., on Sept. 2, with very satisfactory results. A loaded gondola was first run off and the replacers put in position. Upon signal being given, the car rolled back to the track at once. The car was then run up to a curve and backed off, the wheels standing about 18 ins. from the track. The extension or guard rail, a feature peculiar to the Norwood replacer, running crosswise across the track, was then laid down and the wheels were guided up to the replacers and then on to the tracks with apparent ease. The engine, weighing 53 tons, was finally run off an open switch. The replacers were then set in position, and in 12 minutes the heavy engine was again back on the tracks. The replacers are quite different in type from the ordinary portable frogs. They are but 2 ft. long, made of cast steel or malleable iron, and weigh complete 170 lbs. per set. They are reversible, and can be used to replace cars from either direction or either side of the rail. The extension or guide rail is an ordinary piece of track rail, adjusted to the end of the inside frog and carried obliquely across the ties to the opposite rail. The flange of the wheel running against this guides or slews the truck up to the replacers, requiring but one setting and doing away with the jack. We are favorably impressed with the device, which seems to have very good points. It is manufactured by the Norwood Car Replacer Co., 109 North Charles St., Baltimore, Md.

A NEW SYSTEM OF TORPEDO DEFENSE, invented by Gen. ABBOTT, has been tested with considerable success, it is reported, at Willet's Point. Fixed torpedoes are anchored 100 ft. apart and slightly submerged. When a vessel strikes one of them an electric signal, something like a hotel annunciator, designates the number of the torpedo, which can then be exploded by the operator if he so desires.

THE WORST ACCIDENT OF THE WEEK occurred on the recently completed Black Hills & Ft. Pierre R. R. at a point 28 miles east of Deadwood, So. Dak., on Sept. 13. A large pine tree near the track, which had caught fire from a passing engine, fell just as a heavily loaded excursion train was passing, and struck the last car, killing two passengers and wounding seven. The road has been rather unfortunate, having had a bad collision last week between a passenger train and a wrecking train which was at work clearing away a land slide.——A construction train was derailed on the Utah & Northern Sept. 11, killing two men.

TWO LOCOMOTIVE BOILER EXPLOSIONS are reported, one near Concord, Va., on the Norfolk & Western R. R., Sept. 15, killing three men, and one at East St. Louis, on the St. Louis, Kansas City & Colorado R. R., killing the engineer and fireman. The latter locomotive was built in 1883 by the Brooks Locomotive Works, but had been considerably altered and repaired.

COLLISIONS have been numerous but less fatal than usual. Several were due to misplaced switches or freight trains coming off sidings onto the main track in the way of through trains. The New York Central had a rear collision at Schodack, N. Y., Sept. 11, killing one man. A collision on the Cincinnati, Lebanon & Northern in Cincinnati, which killed one man, was due to the runaway of an engine and three cars down a steep grade, made slippery by the heavy rain.

THE REVERSING LEVER broke on one of the engines used to drive the cables of the Pittsburg & Knoxville Incline Ry. on Sept. 11. The engineer was unable to stop the train, and the cars were wrecked when they reached the terminals, but fortunately with no loss of life. The accident indicates gross carelessness on the part of the designer and builder of the machinery.

BRIDGES have been washed away on the Lake Shore & Michigan Southern, near Hadley, Pa.; on the Cleveland, Lorain & Wheeling, near New Philadelphia, O.; on the Pennsylvania at Newcastle, Pa., and on the Delaware, Lackawanna & Western, near Bath, N. Y. Highway bridges have gone down stream at Rose, N. Y., and Bancroft, Neb., and doubtless at many other places, in the late heavy rains.

THE NEW YORK AND NEW JERSEY BRIDGE CO., which was incorporated by the last New York Legislature, and is now seeking a charter from Congress, in opposition to the Lindenthal charter, has received subscriptions of $300,000 to its capital stock, 10% of which has been paid in, and a meeting is to be held for organization on Oct. 1. Among the subscribers are Col. F. K. HAIN, General Manager of the Manhattan Elevated Ry., and THOS. C. CLARKE.

THE WIMAN TUNNEL BETWEEN STATEN AND LONG ISLANDS, it is proposed, shall be built by the New Jersey & Staten Island Junction R. R. Co., controlled by Mr. ERASTUS WIMAN. Bills have been introduced in both houses of Congress authorizing the construction under the waters of the New York Bay. They provide that all railroad companies shall have equal rights to the use of the tunnel, and that in case of dispute as to rates, the Secretary of War shall decide the matter. The tunnel must not interfere with navigation in the harbor, and must be a post route, charging no higher rates on mail matter than are paid to the railways leading to it. Plans for the tunnel must be filed with the Secretary of War, and actual construction must begin within 3 years after the passage of the act. The proposed termini are Stapleton and Bay Ridge, and its length, with the approaches, about 4 miles. Test borings show that the material to be excavated is a hard steatite. Mr. HEMAN CLARK, the well-known contractor, estimates the total cost of the tunnel and approaches at $6,000,000.

WORK ON THE NIAGARA WATER-POWER TUNNEL will be begun at once by contractors Rogers & Clement. About 200 men will be employed at the start. Three 10 × 20-ft. shafts will be sunk to the level of the tunnel, and from them a heading will be run each way. Over a mile of tunnel is to be completed within 15 months. Consulting Engineer COLEMAN SELLERS is now abroad conferring with Sir WM. THOMSON and other distinguished engineers with regard to plans for the economical development and transmission of the power.

## Automatic Block Signaling.

II.

Continuing our description of the Hall signal plant from last week and showing the application of the several parts of the plant already described to practical signaling, the accompanying illustration (Fig. 7) shows the arrangement of battery, wires and

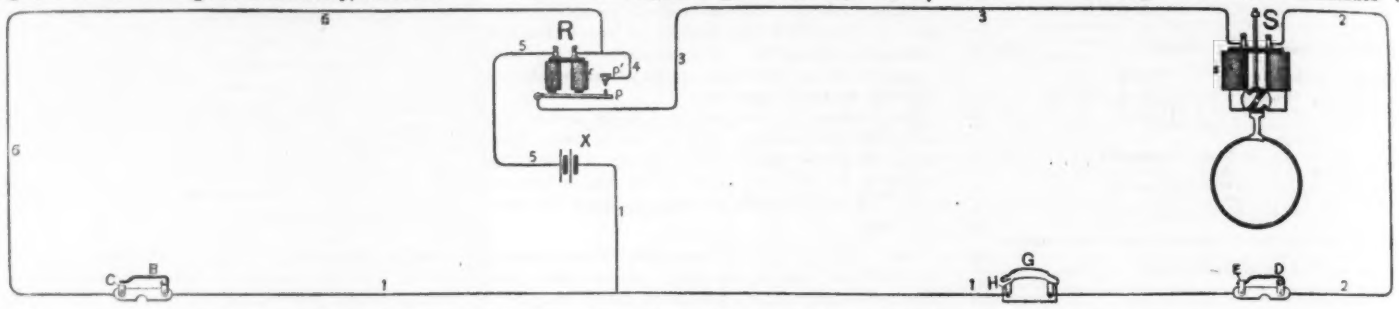



FIG. 7.—ARRANGEMENT OF BATTERY AND INSTRUMENTS FOR A SINGLE BLOCK SIGNAL CIRCUIT.

instruments for operating a simple block signal circuit. The single switch, *G*, shown within the circuit, may for the moment be disregarded. At the entrance of the section is located the "block" track instrument *D*, which sets the signal at danger by breaking the circuit. The similar instrument at the other end is called the "clear" track instrument, its function being to restore the signal to the safety position. These two instruments are alike in principle and construction and the mechanism of both was clearly shown last week in Fig. 4, which showed a "clear" instrument; but in the "block" instrument the piston, when thrown up by a passing train, breaks the circuit, instead of closing it; the contact between spring *D*, Fig. 7, and its anvil *E* being *broken* as long as the spindle is in contact with the spring. In the "clear" instrument, at the other end of Fig. 7, the contact between spring *B* and its anvil *C* is *maintained* while the spindle is in contact with the spring. The "clear" track instrument is located 1,500 or 2,000 ft. beyond the end of the section, so that the longest train will be wholly clear of the section before the foremost wheel touches it. *R* is the relay and *X* the battery. They may be located at any point within the block. In Fig. 7 the circuit is open and signal *S* has dropped to danger from the switch *G H* being open. Were the circuit closed through the battery *X*, wire 1, switch *G H*, anvil *E*, spring *D*, wire 2, electro-magnet *s*, wire 3, contact points *p*, *p'* of relay *R*, wire 4, electro-magnet *r* and wire 5 to battery again, the first train entering the section would open the circuit by breaking the contact between spring *D* and its anvil *E*. Electro-magnets *r* and *s* are then demagnetized, signal *S* falls to danger and the contact between points *p* and *p'* of relay *R* is broken, as shown in Fig. 7.

After the whole of the train has passed over the "block" instrument, the contact between spring *D* and its anvil *E* will be restored, but as the circuit is now broken at *p*, *p'* the signal will remain at danger until *p* and *p'* are again brought in contact, that is, until the train, in passing out of the section completes a circuit that shall energize electro-magnet *r*. This is accomplished (still supposing the switch *G H* absent) by the closing of spring *B* of the "clear" track instrument, which completes a circuit from battery *X*, wire 1, spring *B*, anvil *C*, wire 6, electro-magnet *r*, wire 5 to battery. The contact points *p*, *p'*, are now closed, and the signal circuit is complete; but the signal will remain at danger until the train shall have entirely cleared the "clear" track instrument, from the fact that as long as spring *B* is in contact with its anvil *C* two circuits are completed, one through the "clear" track instrument and relay magnet and the other through the "block" track instrument, signal magnet and relay magnet. As the resistance of the latter circuit is much greater than that of the former, the signal will remain at danger as long as the clear track instrument spring is in contact with its anvil; which, by means of the air cushion, is continuous during the passage of a train at ordinary speed.

It will be seen that the connecting of spring *B* with its anvil *C* is equivalent to the crossing of wires 1 and 6, and that an accidental crossing of these wires would therefore cause the signal to fall to danger. The crossing of wires 1 and 3 would likewise cause the signal to fall to danger, as the current would be withdrawn from the signal magnet. All the normal operations of the signal are by positive closing and opening of the circuit, effected by making and breaking a metallic contact. The disk is held at safety by a simple current of such strength as to make its adjustment easy, and variations in its strength should involve neither danger nor inconvenience. As the main current can be of any desired strength, no relay or other device for multiplying power is required. The movements of the relay magnet are equally positive and simple, and its armature needs no spring or delicate adjustment.

When there is a switch in the circuit of the block section, as shown in Fig. 7, the throwing of the switch from the main line breaks the contact between spring *G* and its anvil *H*, opening the circuit and causing the signal to fall to danger the same as if a train opened the circuit by operating the "block" instrument; and so long as the switch is misplaced the signal cannot be cleared. It is evident that any number of switches may be included in the circuit, and that the entire plant as shown can be used to protect a switch only, by omitting the track instruments *C B* and *E D* from the circuit. This is often done when a complete block signal plant is not desired.

Fig. 8 is a sketch showing the arrangement of the actual signals as placed along a line of a double track road. The distant signals are exact duplicates of the home signals, except that their disks are of green silk instead of red. They are included in the same circuit and work simultaneously with the home signals. The whole is purely automatic. The foregoing describes the circuit for a simple block section. Where it is desired to use only the "permissive block" system, i. e., to sometimes admit a second train into a section before the first has passed out of it, a combination of relays and track instruments is provided whereby the second train, on passing the clearing track instrument for section *A* cuts out the clearing track instrument for section *B*, so that the first train cannot clear the signal for that section *B*. This signal therefore continues to stand at danger and protects the second train. A third or fourth train produces the same effect, and only the last train of the series can clear the signals.

There can be no doubt, however, that the permissive blocking is much less than half as good a safeguard as the absolute block, the only motive for it being that it enables the blocks to be made longer without too much interruption of traffic. One of the great advantages which automatic block signaling promises is to do away with the serious additional expense from short blocks which is inevitable when human agency is employed at each.

We now come to the methods for interlocking signals. When two or more interlocking instruments, such as were shown in Fig. 6 last week, are combined, the operation of any

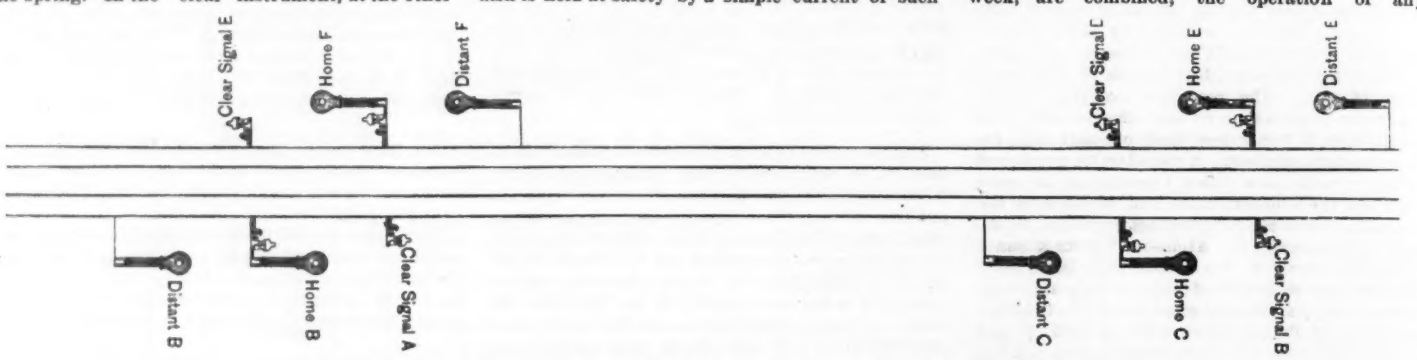



FIG. 8.—BLOCK SIGNAL ARRANGEMENT FOR DOUBLE TRACK LINF.

one is dependent upon the position of the advancing springs of the others. Fig. 9 shows two instruments interlocked. The principle may be thus explained: Circuit-closing key *x* unlocks instrument *X* and key *y* unlocks instrument *Y*. The instruments are shown in their normal position (locked), and either of the instruments may now be unlocked by their respective keys. To unlock *X*, key *x* is closed and a circuit is completed from the battery, wire 1, key *x*, wire 2, spring *C'*, anvil *c'*, wire 3, electro-magnet *B*, wire 4 to battery. Electro-mag- *B* is energized, and its armature being attracted the armature of *A* is unlocked and the contact between advancing spring *C* and its anvil *c* is broken.

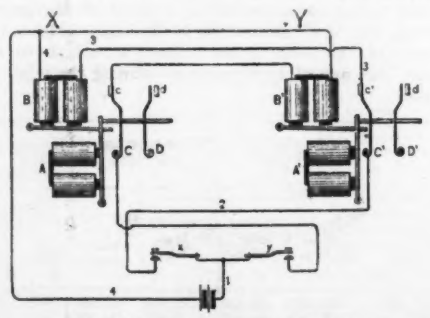



FIG. 9.—Two Instruments Interlocked.

It is now impossible to unlock instrument *Y*, from the fact that the circuit of electro-magnet *B'* is broken at *c*.

Fig. 10 shows three instruments interlocked. Key *x* unlocks instrument *X*, key *y* unlocks instrument *Y*, and key *z* unlocks instrument *Z*. To unlock *X* key *x* is closed and a circuit is completed from the battery, wire 1, key *x*, wire 2, anvil $c^2$, spring $C^2$, wire 3, spring $E^1$, anvil $e^1$, wire 4, electro-magnet *B*, wire 5, to battery. Electro-magnet *B* is energized, and its armature being attracted, the armature of *A* is unlocked, and the contact between advancing springs *C* and *E* and their respective anvils *c* and *e* is broken. It is now impossible to energize either electro-magnet *Y* or *Z* from the fact that the circuits of electro-magnets $B^1$ and $B^2$ are broken at *c* and *e* respectively. In like manner four or more instruments may be interlocked by the addition of an advancing spring for each instrument so added.

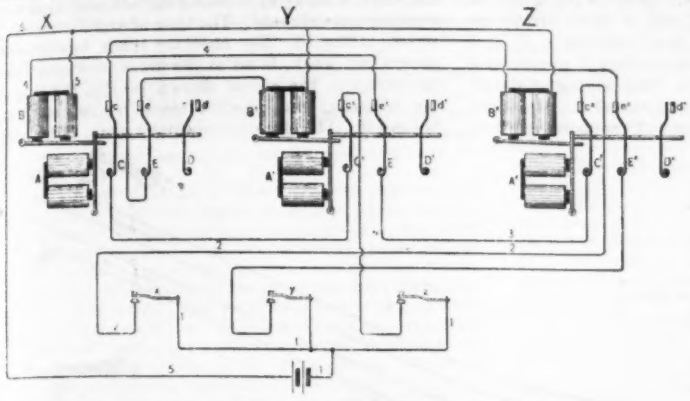



FIG. 10.—THREE INSTRUMENTS INTERLOCKED.

Fig. 11 shows two signals interlocked, the circuit of each signal being completed through the retreating springs of their respective interlocking instruments. Signal *R* is in circuit with the battery through the retreating spring *D* and its anvil *d* of instrument *X*, and signal *T* is in circuit with the battery through the retreating spring *D'* and its anvil *d'* of instrument *Y*. When these instruments are in their normal position (locked) the contact between springs *D* and *D'* and their anvils *d* and *d'* is broken; consequently signals *R* and *T* are at danger. In the figure, instrument *X* has been unlocked; the contact between advancing spring *C* and its anvil *c* is broken, and contact is made between retreating spring *D* and its anvil *d*; signal *R* is therefore at safety, its circuit being completed from battery, wire 1, spring *D*, anvil *d*, wire 5, electromagnet of signal, wire 4 to battery. As it is impossible to energize electro-magnet *B'* by operating circuit-closing key *y* (see Fig. 9) as long as the contact between spring *C* and its anvil *c* is broken, signal *T* cannot be moved to safety as long as signal *R* is at safety. To move a signal from its normal position of danger to a position of safety, contact must be made between the retreating spring of its interlocking instrument and the corresponding anvil, and as the circuits to the unlocking magnets of the other interlocking instruments are broken through the advancing springs of this instrument, it is impossible to change the position of any of the remaining signals from danger to safety.

When one of a series of interlocked electric signals has been moved from its normal position of danger to a position of safety the train for which the signal was thus cleared operates a track instrument as it passes the signal and returns it to danger; and upon reaching the clearance point it operates a second track instrument, which restores the interlocking instruments to their position.

In Fig. 12, *W* is the interlocking instrument of signal *S*, which is one of a series of four interlocked signals (as, for instance, for a grade crossing) which may be moved from their normal position of danger to a position of safety by circuit-closing keys placed under the control of an operator. In the figure, *W* is unlocked, and the retreating spring being in contact with its anvil, signal *S* is at safety and the circuits to the unlocking magnets of the three other instruments are broken through the advancing springs *C*, *E* and *F*, respectively. *V* is an interlocking instrument provided with an advancing spring only, and whose function is to cause signal *S* to return to its danger position as the train passes the signal. Spring $C^1$ of instrument *V* is in the circuit of signal *S*. *V* is locked and a circuit being completed from battery, wire 1, anvil *d*, spring *D*, wire 2, spring $C^1$ anvil $c^1$, wire 3, electro-magnet of signal *S*, wire 4 to battery, the signal is at safety. A passing train operates the track instrument *s* located at the signal and closes a circuit which is completed from battery, wire 4, circuit-closer *s* of track instrument, wire 5, electro-magnet $B^1$, wire 1 to battery. The contact between spring $C^1$ and its anvil $c^1$ being thus broken, the signal falls to danger. When the train reaches the clearance point it operates a second track instrument, *t*, and closes a circuit which is completed from battery, wire 4, circuit-closer *t* of track instrument wire 6, electro-magnet *A*, wire 7, electro-magnet $A^1$ wire 1 to battery. Electro-magnets *A* and $A^1$ of instruments *W* and *V* are energized, and the advancing springs being closed the control of the signals is again placed in the hands of the operator. In this way it is insured that, at points where human intelligence is required to designate the train that shall have the right of way, after a train has once accepted and used a signal, no conflicting signal shall be cleared until that train shall have operated the track instrument at the clearance point.

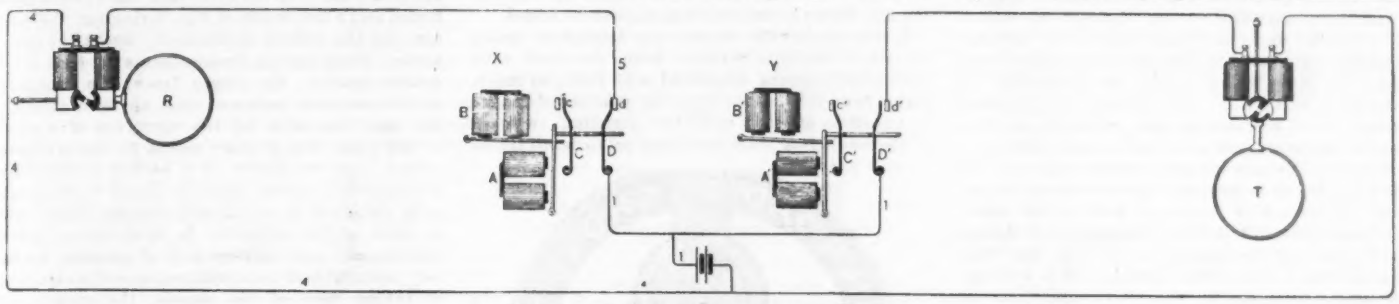



FIG. 11.—TWO SIGNALS INTERLOCKED.

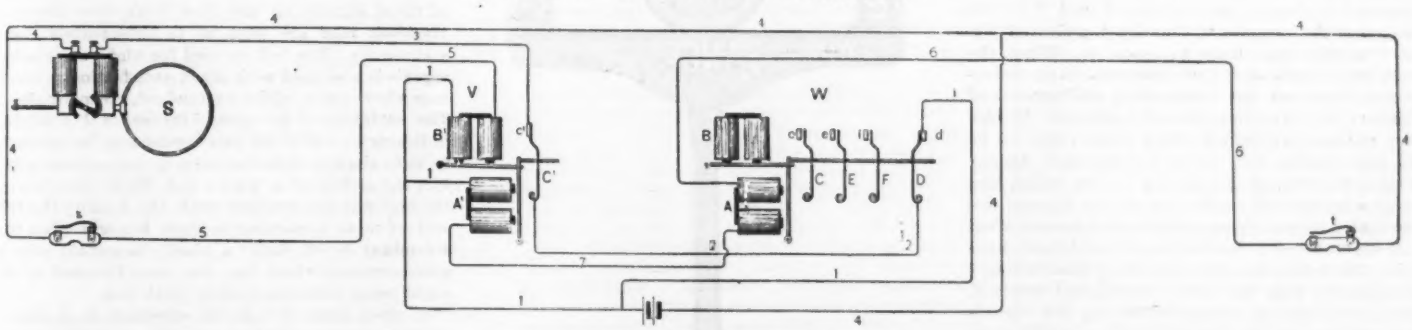



FIG. 12.—FOUR INTERLOCKED SIGNALS.

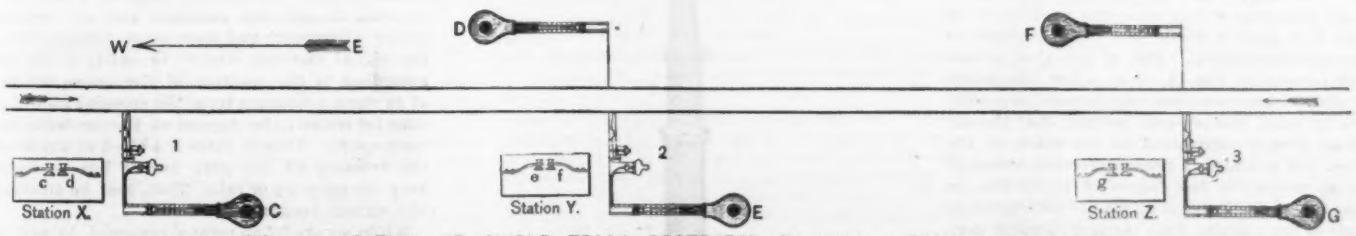



FIG. 13.—SECTION OF SINGLE TRACK PROTECTED BY HALL INTERLOCKING SIGNALS.

Turning now to the application of these principles, in Fig. 13 is shown a section of single track protected by two interlocked signals *C* and *D*. When signal *C* is moved from danger to safety by circuit-closing key *c*, in the hands of an operator at station *X*, an east-bound train in passing the signal restores it to danger by operating track instrument 1. From

the moment that signal *C* is cleared by the operator all human control over either signal *C* or *D* is lost until the east-bound train shall have reached the clearance point, when, by operating track instrument 2, it will restore the signals to the control of the operator. If signal *D* is moved from danger to safety to allow a west-bound train to pass through the section, the train, by operating track instrument 2, restores the signal to danger, and by operating track instrument 1 it restores the signals to the control of the operator.

Fig. 13 also shows a series of interlocked signals, *C*, *E* and *G*, governing east-bound trains, and signals *F* and *D* governing west-bound trains. Signals *C* and *D* are controlled by the operator at station *X*. Signals *E* and *F* are controlled by the operator at station *Y*. Signal *G* and the next signal east governing west-bound trains are controlled by operator at station *Z*. The operator at *X* clears signal *C* for an east-bound train, which in passing signal *C* operates track instrument 1 and returns it to danger. The operator at *Y* clears signal *E* for this train, which in passing *E* operates track instrument 2 and returns *E* to danger, and at the same time restores the interlocking instruments of signals *C* and *D*, so that the operator at *X*, if he has been notified from *Y* that a west-bound train is waiting, may now clear signal *D*. The west-bound train in passing signal *D* operates track instrument 2, which returns *D* to danger and restores *E* and *F* to the control of the operator at *Y* (he having cleared signal *F* to allow this train to reach *D*). When the west-bound train shall have operated track instrument 1 it restores the interlocking instruments of signals *C* and *D* to their normal condition. In this way a system is obtained which many claim to be the most perfect, viz.: one in which human agency is employed to work the signals, but in which the dangers incident to unchecked human agency are eliminated by some form of mechanical interlocking.

As applied to the interlocking of yards and junctions, this system has the undoubted disadvantage, as compared with the direct mechanical systems, that it furnishes the means for moving the signals only, and not the switches themselves, which must be thrown by hand or by independent interlocking plant. For many locations, consequently, where there are numerous widely scattered switches to be worked, this spstem would not be as suitable as mechanical interlocking. But at junction points, like that shown in Fig. 14, or at other like points where the switches are close together and so readily thrown by hand, this system insures that the signals shall always correspond to the state of the switches, and so affords a great protection, although it does not insure the last degree of protection, by insuring that the switches shall always correspond to the state of the signals; for a careless operator may throw them wrong in the face of an approaching train, which has passed the signals.

Fig. 14 shows a junction protected by three interlocked signals, *A*, *B*, and *C*, all at danger, and a switch signal *D*. *S* 7 and *S* 8 are switch instruments connected to switches *X* and *Y*, respectively. In addition to signals *A*, *B*, and *C* being interlocked with each other, signal *A* cannot be moved from danger to safety unless swhitch *Y* is placed on east-bound branch line, signal *B* cannot be moved from danger to safety unless switches *X* and *Y* are both set for main line, and signal *C* cannot be moved from danger to safety unless switch *X* is set for the branch. Signal *A* governs east-bound trains that go to the branch. Signal *D* governs east-bound through trains. It is connected with switch instrument *S* 8 and the signal will fall to danger whenever switch *S* 8 is thrown from the main line. The moving of signal *A* from danger to safety locks signal *B*. The train restores *A* and *B* to the control of the operator when it passes and operates track instrument 6. The moving of signal *B* from danger to safety locks *A* and *C*. The train restores *A*, *B*, and *C* to the control of the operator when it passes and operates track instrument 4. The moving of signal *C* from danger to safety locks signal *B*. The train restores *B* and *C* to the control of the operator when it operates track instrument 4. "Back-up signals, are not shown in the drawing, but can be added.

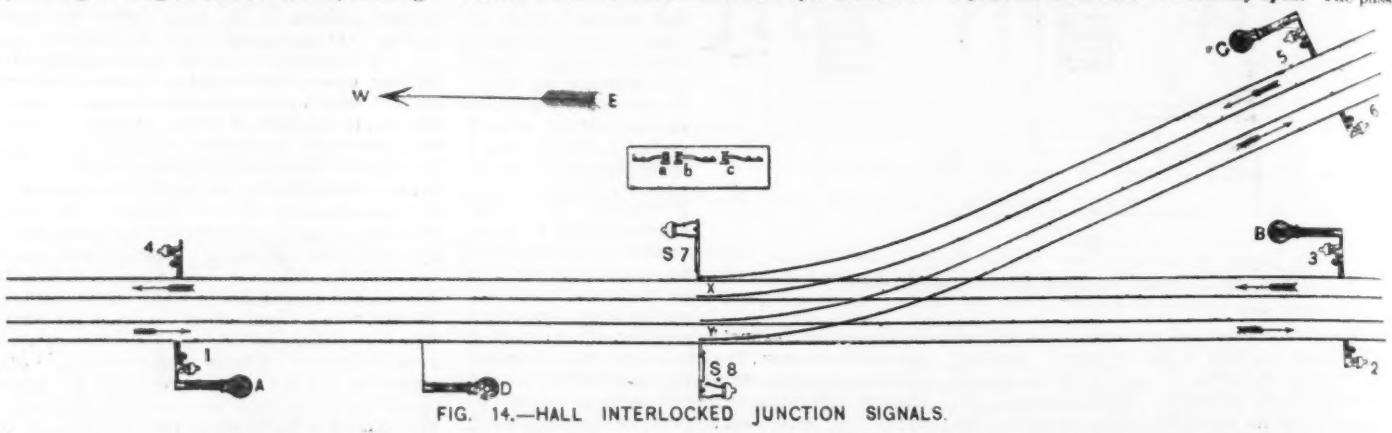



FIG. 14.—HALL INTERLOCKED JUNCTION SIGNALS.

In like manner the signals are applied at grade crossings, derailing switches being provided with switch instruments connected with them, so that a signal cannot be moved from its position of danger to a position of safety until the derailing switches of the conflicting track have been set to derail trains approaching on those tracks. If side-tracks are introduced between the crossing and clearance point, the control of the signals will be returned to the operator by the train passing over an additional track instrument, located on the side-track, having the same function as the clear track instrument on the main line; or, by closing a circuit in a switch machine in returning the switch to the maine line. In the operator's cabin is located the interlocking operating board, on which are placed, in addition to the hand keys and interlocking instruments, indicators showing the condition of the signals, and also announcing when a train enters or leaves the protected section.

FIG. 15.—Hall Audible Crossing Signal.

In addition to these more elaborate uses, the Hall plant is admirably adapted to, and is much used for, audible highway crossing signals and highway crossing gate signals. The type of audible signal is shown in Fig. 15. The ordinary track instrument, shown last week, is set at the proper distance from the crossing, the signal shown in Fig. 15 being at the crossing, and another track instrument just beyond it. The circuit is normally open. The passage of a train over the first track instrument closes it and sets a bell inside of Fig. 15 ringing; the passage over the second instrument breaks the circuit again. These are the arrangements for each of two double tracks. On single track, the experience of the company indicates that an open circuit is the most desirable for the operation of a signal of this kind. The primary reason for using a closed circuit—that the failure of a battery or wire shall automatically reveal itself—is found to be practically valueless in a highway crossing signal; and, in view of the reduction in first cost of wires, instruments and battery, and of expense for battery material and maintenance, as well as the labor of taking care of the signals, the open circuit system is preferred. The records of the operation of these signals on the New York, New Haven & Hartford road are such as to substantiate these statements. The bell as used for highway crossing signals is also used with much satisfaction at crossings where gates, with an attendant, are maintained. The certainty of its operations makes it a reliable indicator by which the gate-tender may be notified, so as to always close the gates in proper season before the arrival of a train; and while travelers on the highway are familiar with the locality the bell will serve as a warning to them at night when the attendant is off duty; a highly important gain, a gated crossing which has the gates fastened up at night being little less than a death trap

Another plant for gated crossings is a signal showing danger or safety to trains, according as the highway crossing gates are opened or closed. First comes a track instrument ringing a bell at the crossing to give the gateman and all concerned notice of danger; and then, some distance beyond, the signal showing danger or safety to the train, according to the position of the gates, this being at as short a distance from the crossing as will give time for trains to be stopped at the probable maximum speed. Thus if there is a block of any kind at the crossing all the gate keeper has to do is to keep the gates up or raise them, and he automatically signals danger to the train.

While we are by no means prepared to say that these various signal plants ought to be used at all the points where the company suggest that they are applicable, yet they are all of them, so far as we can learn, of great and proven merit and deserving of, as they are receiving, wide and increasing use.

The Hall Signal Co. is a reorganization of the Hall Railway Signal Co., and it has offices at 50 Broadway, New York, and Rookery Building, Chicago. Its officers are WM. P. HALL, President; W. S. GILMORE, Treasurer; and A. W. HALL, General Manager. It has now in press a very elaborate catalogue, explaining everything about its plant in the most minute detail, copies of which can doubtless be obtained on application.

## The Sheffield (England) Water-Works.*

The town of Sheffield is supplied with water by gravitation from the elevated moorlands lying to the west and northwest, the gathering grounds forming part of the western slope of the backbone of England. The rainfall has been continuously gauged for the last 54 years, and averages rather more than 40 ins. in depth per annum. Of this it has been ascertained from actual experience that during a period of three consecutive dry years nearly 20 ins. can be collected, stored and distributed.

The system of reservoirs may be divided into the high level and the low level, the distinction having reference, not to absolute height above the sea, but to the means available for conveying the water from the storage reservoirs into the various service reservoirs near the town.

*High-level Reservoirs.*—The high-level reservoirs are situated at Redmires, about 6 miles in a direct line from the center of the town, these reservoirs being among the earliest of the large works constructed by the late Water-Works Co. They consist of three reservoirs—the Upper, Middle and Lower Redmires—with the Oaken Clough Dam and Catch-water. They receive the flow from 2,108 acres of drainage area, and have a tot l storage capacity of 670,000,000 galls., the gathering ground comprising the upper part of the valley of the River Rivelin. The water from the high-level reservoirs is conveyed down a water-course, open for the greater part of its length, but covered in at the lower end, into the Hadfield or Crookes service reservoir having a capacity of more than 21,000,000 galls., whence the supply is taken for the higher parts of the town.

*Low-level Reservoirs.*—The low-level system comprises two reservoirs upon the river Rivelin, originally constructed for mill compensation purposes, in consideration of water taken from the high-level system. Under the Sheffield Water-Works Act of 1853 these Rivelin reservoirs reverted to the Water-Works Co., compensation to the stream being provided for by the flow, over a notch gauge or weir, of 7 cu. ft. per second during 24 hours of every working day. The other portion of the low-level supply is composed of four reservoirs in the adjoining valley of the river Loxley, these being the Strines, Dale Dike, Agden and Damflask reservoirs. There is also upon the River Rivelin, immediately above the mill-compensation gauge, a small reservoir called the Depositing Pond, constructed for the purpose of regulating the flow of water for the mill gauge. The total capacity of the low-level system of storage reservoirs is more than 3,000,000,000 gallons, details of which are shown in the accompanying table, which also shows the area of water-shed draining down to each system of reservoirs. The water collected in the Strines, Dale Dike, and Agden reservoirs is conveyed through a tunnel, passing under the high ridge which divides the Loxley from the Rivelin water-shed; and uniting at the depositing pond with the water from the Rivelin reservoirs, passes through a conduit and tunnel to the service reservoirs at Crookesmoor lying immediately west of the town.

EXISTING RESERVOIR CAPACITIES AND AREAS OF GATHERING GROUNDS.

| Reservoir. | | Capacity. Galls. | Gathering Ground. Acres. |
|---|---|---|---|
| *High level.* | | | |
| Redmires Upper | | 343,000,000 | |
| Redmires Middle | | 187,500,000 | |
| Redmires Lower | | 139,500,000 | |
| Total of high level | | 670,000,000 | 2,108 |
| *Low level.* | | | |
| River Rivelin | Rivelin Upper | 48,500,000 | |
| | Rivelin Lower | 175,000,000 | 2,870 |
| | Depositing Pond | 5,000,000 | |
| River Loxley | Agden | 629,000,000 | 2,999 |
| | Strines | 513,000,000 | 2,890 |
| | Dale Dike | 436,000,000 | 1,089 |
| | Damflask | 1,158,000,000 | 3,747 |
| Total of low level | | 3,017,500,000 | 13,595 |
| Total high level and low level | | 3,687,500,000 | 15,703 |

In the valley of the River Ewden, lying immediately north of the Loxley Valley, the Corporation of Sheffield have power to construct two other reservoirs, namely, the Broomhead and Moorhall reservoirs, for receiving the flow from a drainage area of 6,496 acres; but these works have not yet been commenced.

*Summary of Supply.*—The total drainage area of the works is 15,703 acres. The total available water during three consecutive dry years is 19,460,000 galls. per day, of which an average of 9,113,472 galls. per day has to be sent down the streams as compensation water, leaving 10,346,528 galls. per day for the supply of the town and district. It will thus be seen that nearly one-half of the available supply of water has to be sent down the rivers for the benefit of the mill owners and other riparian proprietors.

*Redmires Middle Reservoir.*—In order of date the first storage reservoir constructed was the Middle reservoir at Redmires. This reservoir has an embankment 3,036 ft. in length, the greatest depth of water being 36 ft., and it is provided with two overflow weirs or bye-washes, respectively 70 and 104 ft. in length. Water is drawn off by means of valves, placed in a masonry shaft and discharging into the lower reservoir, the valve-shaft being connected with the bank by a wooden bridge constructed in 1834. This bridge is now much decayed, and is on the point of being replaced by a bridge made of iron.

*Redmires Lower Reservoir.*—The next reservoir in point of age is Redmires Lower, constructed in 1847. The depth of water is 29 ft., and the length of the bank is 1,770 ft. Here both the water for supply and the flood water are conveyed through a valve and overflow shaft into a culvert passing through the bank, means being provided on the outer slope of the bank for passing surplus or flood water into the Wyming brook and River Rivelin; while the water required for the town is taken into a gauge basin, measured through a notch, and sent down the water course into the high-level service reservoir.

*Redmires Upper Reservoir.*—The Redmires Upper reservoir, constructed in 1853-4, receives the water from its own gathering ground, and also, by means of a catch-water drain, the additional yield at the Oaken Clough drainage area. This reservoir has a bank 2,340 ft. in length, the water being drawn off by means of two lines of pipes 14 ins. in diameter laid through the bank, terminating at their inner end in a vertical cast-iron valve tower or shaft.

These three Redmires reservoirs may be taken as types of the old practice of reservoir construction in this country. The predominant features are banks of earthwork with a puddle wall in the center, the depth of water rarely exceeding 40 ft., and the absence or insignificance of masonry or brickwork.

*Rivelin Reservoirs.*—The same general features distinguished the next two reservoirs to be described, namely the Upper and Lower Rivelin reservoirs. These two reservoirs were constructed under the Sheffield Act of 1845, to be vested in the mill owners, who had full control over them, and power to draw off water from them as they thought fit. They were of a capacity agreed upon between the water-works company and the mill owners; and having a gathering ground far in excess of their storage capacity, a bye-pass channel or river diversion was constructed, by means of which excessive floods were prevented from entering the reservoirs, or when these were full the whole flood from the drainage area was diverted past them. Each reservoir is provided with an overflow weir or bye-wash, and water is drawn from them by means of a pipe 24 ins. in diameter.

These five reservoirs, namely the three at Redmires and the two on the Rivelin, were designed and constructed by the late Mr. JOHN TOWLERTON LEATHER, who from 1830 to 1865 was the engineering adviser of the late water-works company. Since the latter date the engineers responsible for the large and important reservoirs upon the Loxley have been Messrs. T. and C. HAWKSLEY.

*Depositing Pond.*—In the Rivelin valley the Depositing Pond, also constructed by Messrs. HAWKSLEY, is principally remarkable for its fine overflow weir and bye-wash capable of conveying away the heavy floods which are occasionally discharged from the area of nearly 5,000 acres draining down to this point.

*Agden Reservoir.*—In the Loxley water-shed, the first reservoir constructed was that upon the Agden dike, having a storage capacity of 629,000,000 galls., the embankment being nearly 100 ft. high and containing 900,000 cu. yds. of material. The water is drawn off from the reservoir by means of a valve shaft and a culvert laid through the bank, controlled by two valves which are worked by gearing upon the top of the shaft. From the outlet culvert the water discharges into a gauge basin, where provision is made by means of a slot gauge or orifice for passing a measured quantity of compensation water down the stream. The measuring opening or slot is made capable of accurate adjustment by sliding jaws of steel, which when adjusted are locked by two padlocks; the key of one is in the hands of the clerk to the mill-owners, while that of the other is in kept at the water-works office; it therefore requires the consent and presence of both parties to make any alteration in the measuring apparatus. The same description of slot gauge is in operation at each of the four reservoirs upon the Loxley.

*Strines Reservoir.*—The Strines reservoir at the head of Bradfield Dale has a bank 1,254 ft. in length, the water being drawn off by means of a shaft and a culvert through the bank. This embankment, in common with those of the other Loxley reservoirs, has an inside slope of 3 to 1; the outer slope is 2¼ to 1, and is strengthened by level benchings.

*Dale Dike Reservoir.*—Immediately below the Strines reservoir is the Dale Dike reservoir, upon the site of, but considerably smaller than, the ill-fated reservoir which was destroyed by the disastrous inundation of March 11, 1864. The embankment which was then destroyed crossed the valley obliquely, about a quarter of a mile below the present bank; and before the reservoir was completely filled with water a landslip led to a settlement in the outer slope of the embankment, causing the puddle wall to subside and the water to flow over the top of the bank. In a few minutes the reservoir was destroyed, and the valley down to Sheffield was inundated, causing the death of 244 persons, and destruction of an enormous amount of property. The water company paid no less a sum than $1,865,000 in respect of injury and loss sustained, the disaster being happily unique so far as regards this country.

The embankment for the new reservoir was made higher up the valley, in order to avoid the treacherous ground upon which the old bank stood; but it may be interesting to state that the pipes which ran under the old bank, and which were alleged to have caused the disaster, are still in the ground, and are as tight and strong as the day they were laid. The water is drawn out of the present reservoir by means of a tunnel driven through the solid rock round the end of the embankment; two valves are provided, one behind the other, and the gearing for working them is placed in a small house near the overflow weir; the outlet from the tunnel is in a line with the foot of the bye-wash. This reservoir was completed and filled with water in 1875, but was not found necessary to be brought into use until the exceptionally dry year of 1887.

Rather more than a mile below this reservoir, and at the junction of the Dale Dike with the Agden Dike at Low Bradfield, is the mill-compensation gauge, over which is passed for the use of the mill-owners a quantity of water equal to 10 cu. ft. per second during 24 hours of every working day. In a small house alongside this gauge there is a recording machine designed by the writer for the purpose of continuously measuring the water flowing over the gauge bar.

*Damflask Reservoir.*—Immediately below this mill gauge is the tail end of the largest, and in some respects most important, reservoir belonging to this undertaking, the Damflask reservoir, which is the lowest upon the river Loxley, and has a storage capacity of 1,158,000,000 galls. with a depth of water of 85 ft. The water is drawn off by means of two culverts through the bank, each provided with a valve shaft on the inner end. Having regard to the great size of the reservoir, the embankment is not long; but the works in connection with it are enormously heavy and costly. When the reservoir is filled with water up to a certain height, it has been ascertained that a band of rock upon the south side allows the water to pass through the joints and fissures, to reappear as a spring at the bottom of the embankment. It was foreseen that this might prove to be the case; but as it was uncertain what the quantity of the water passing might be, it was considered better to defer remedial measures until the reservoir was filled and proved. To stop this percolation, a wing trench is being cut through the pervious rock into the underlying shale, which will be filled with puddle, and so stop the water from passing away. This work is now in progress. At the foot of the embankment is placed the mill-compensation gauge-weir, having three slots or openings similar to those already described; while in a little house adjoining is another gauge, similar to that at Low Bradfield.

*Distribution.*—After leaving the storage reservoirs and being received into service reservoirs at Crookesmoor, the water is distributed throughout the town and district of supply by means of main pipes from 24 ins. to 5 ins. in diameter, laid in zones. The service pipes are mainly 4 ins. in diameter, 3-in. pipes being laid in short streets and courts. The total length of the distributing pipes is nearly 300 miles. The total daily quantity of water distributed is about 6,500,000 galls., of which exactly one-third is for trade and manufacturing purposes, or for supplies in bulk to local authorities distributing water themselves.

When water was first supplied to Sheffield under constant pressure in 1869, the daily consumption was 40 galls. per head of the population supplied, of which only about 2¾ galls. per head was for trade purposes. Now, and for many years past, the quantity consumed without restriction or limitation, for all purposes other than meter supplies, has averaged not more than about 13 galls. per head per day; this happy result is due to the rigorous rejection, so far as practicable, of fittings and apparatus of an inferior character combined with unceasing vigilance in suppressing all unnecessary waste of water.

*Self-Recording Gauges.*—At each of the service reservoirs a self-recording gauge, similar in construction to those at Low Bradfield and Damflask reservoir, is fixed for the purpose of measuring the water supplied to the town. These recorders have been in use since 1878; and the result of their working has been to disclose several facts relating to the supply of water, of a character very interesting to all engaged in the practical management of water-works. A diagram has been prepared showing the curve of the average draught of water during 24 hours starting from midnight, for the period of twelve years from 1878 to 1889, inclusive; and by throwing these results into another form, the hourly percentage on the draught is ascertained. From the latter diagram it is apparent that, so far as Sheffield is concerned, the least draught upon the reservoirs is between three and four o'clock in the morning, the maximum draught being between eleven and twelve noon; while the fact of the stoppage of work for dinner between twelve and one o'clock is strikingly manifested. The diagram further indicates that in proportioning pipes for town supply, although the average daily flow through the pipes may be taken at 100, yet provision must be made for passing 50% in excess of this quantity.

In connection with the system of pipes for water supply, it may be interesting to compare the two specimens of

* A paper by Mr. EDWARD M. EATON, Engineer, read at the Annual Convention of the Institution of Mechanical Engineers, Sheffield, in July, 1890.

pipe exhibited, each being 5 ins. inside diameter. One of these is the modern cast-iron pipe, as now laid in the streets of Sheffield; the other is a wooden pipe formerly used, which was taken out of the ground during May last, after having probably lain there nearly, if not quite, a century. These wooden pipes were made upon the water-works premises, and the last of them was laid about 60 to 70 years ago.

*Quality of Water.*—The water supplied to Sheffield may be taken as a fair type of the excessively soft upland waters supplied to many of the large towns in the north of England. The hardness varies at different periods of the year, rarely falling below two degrees of Dr. Clarke's scale, and seldom exceeding three degrees. The extreme energy displayed by these soft waters in attacking metals exposed to their action is well shown by the specimens now exhibited of wrought-iron screw-spindle, nuts, bolts and washers. These have been wholly immersed in the water to a considerable depth for a period of more than forty years; and the manner in which the pure metal has been eaten away is most remarkable. It has been found also that steel blades, such as razors, scissors, pocket and table knives, and also files, suffer complete deterioration to a considerable depth from the surface of the metal when immersed in the water for several years. This has been proved by the recovery from time to time from the reservoirs of bundles of such steel articles, which had doubtless been placed there in connection with trade outrages in times past. The steel was found to have become converted into plumbago, whole bundles of blades being capable of being scraped away with a penknife. This fact should induce caution in the use of cast steel, when wholly and continuously immersed in water of this character.

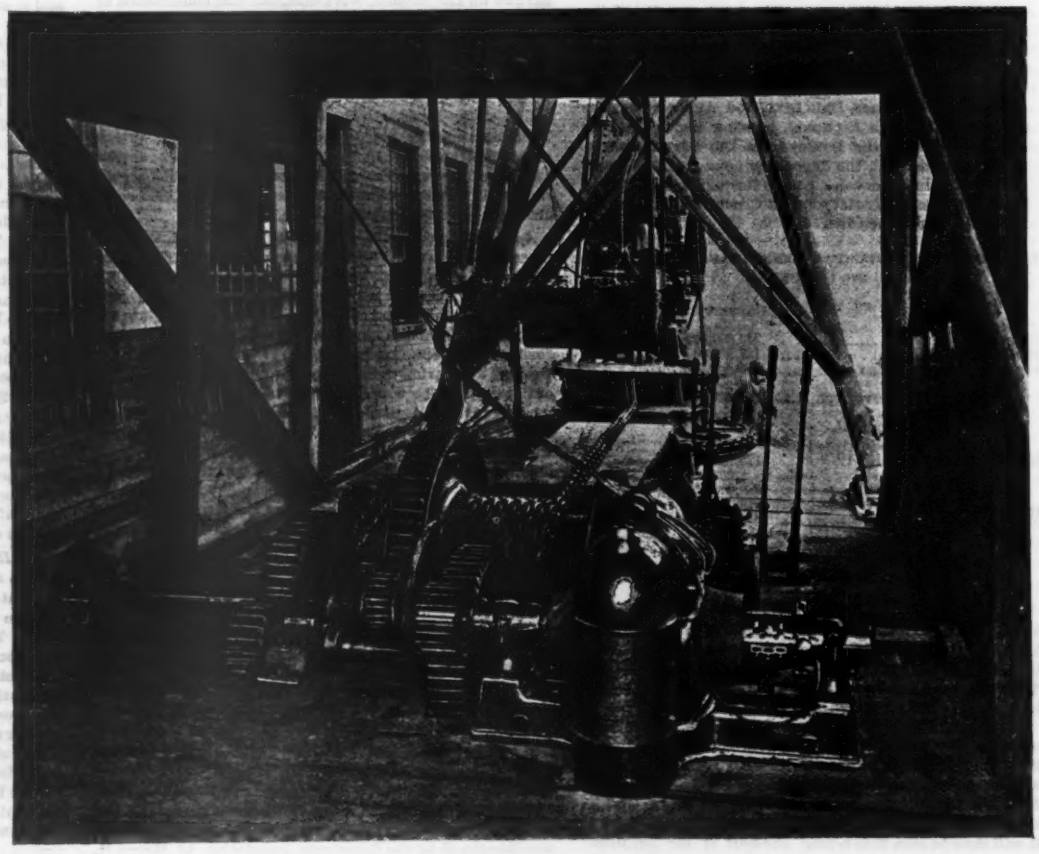
The Corporation of Sheffield supply water to more than 320,000 persons. The revenue from water rates is $450,000 per annum. The capital cost of the undertaking, as shown by the accounts to March 25, 1890, has been upward of $10,575,000.

## Electric Motor Excavator, Osgood Dredge Co.

While electric motors are rapidly coming into general use for many purposes, one of their latest applications is as motors for excavating machinery. They are thus used by the Osgood Dredge Co. in the plant illustrated herewith. It is reasonably claimed that electricity is admirably adapted for such use in all respects, and especially in that its capability for being transmitted great distances renders it not only possible, but economical to use excavators and dredges in many places where the great cost of fuel or water would otherwise prevent their use. The cut herewith represents the interior of one of the Osgood No. 2 excavators, fitted with Sprague electric motors instead of engines and boiler. This machine was built for the Bennett Amalgamator Co., of Denver, Col., to be operated in conjunction with one of their amalgamators in gold-bearing gravel beds.

The complete plant includes a 100-HP. dynamo driven by water power, from which the electricity is carried about 1½ miles to the mines, where it operates the shovel, a conveyer, the amalgamator, two pumps and an electric light plant, all driven by the same current, an unusually good illustration of the value of the motors for different kinds of work. The shovel is operated by one 25-HP. standard motor and one 15-HP. street car motor, both reversible. In addition, the 25-HP. motor which drives the conveyor and the amalgamator is mounted on the car. The conveyor is mounted on one side of the shovel, so that the shovel practically dumps on itself, and the amalgamator is coupled to the shovel and, with the conveyor, driven by the second 25-HP. motor by link belt. Only the motors belonging to the shovel are shown in the cut.

In operation it has been found that the power is ample to dig cemented gravel, that it is so elastic as to materially relieve the shocks which are the chief cause of breakages in excavating machinery, and that it automatically adjusts itself to the work, pulling hard at a slow speed while the dipper is loading itself in the bank, and working quickly and easily while swinging and returning the dipper, while it does away with a fireman and all the annoyances inseparable from the use of steam.



ELECTRIC MOTOR EXCAVATOR, OSGOOD DREDGE CO.

## Electricity in Warfare.*

About four years ago a lecture was delivered before this institute on the subject of "Electricity in Warfare." This evening the endeavor will be made to present the present condition of the art, to show what advance has been made in the intervening years, in what ways electricity is now employed, and what is the direction of progress.

At the time of the previous lecture, November, 1885, nearly the whole science was in a transition stage; electricity was just emerging from the laboratory and entering the region of practical life; there was but one war ship lit by electricity actually at sea, and her plant was so defective and accidents on board from imperfect insulation were so frequent that many concluded that the only effect of her electric equipment was to prove the impracticability of the attempt. Much of that lecture was devoted to maintaining the advantages of electric lighting for ships; now it will be unnecessary to do more than to say that every war-ship possessing any pretensions whatever to modern equipment is lighted by electricity.

### SUBMARINE MINES.

As mentioned in my previous paper, the first practical plan for employing electricity in warfare was proposed and executed by Col. SAMUEL COLT, and embodied what is now called the submarine mine, or stationary torpedo. During the past five years it cannot be said that very much progress has been made in submarine mining, for it had then reached a very advanced stage, so that it was practicable to lay out in any harbor a system of electric mines which could be relied upon to blow up any hostile ship trespassing on the premises, and to allow any friendly ship to pass without molestation. Defending a harbor with mines is simply carrying out with more or less elaboration a system by which a large number of water-tight tanks, holding from 100 to 1,000 lbs. of gun cotton or other explosives, are anchored in carefully defined positions and connected by electric cables with protected operating rooms, in which are batteries, measuring instruments, etc. The more complete mines have usually floating above each of them an automatic circuit closer, in which two contact points are jarred together by a passing ship, and thus afford a passage for the electric current to the fuse in the torpedo. Ordinarily, this current is a weak one, sufficient only to close a relay in the operating room, which sends in turn another current through a bell or other indicator, but not strong enough of itself to fire the torpedo. But when hostile ships are expected, then the relay is arranged to throw in a strong current, strong enough to heat the fine platinum iridium wire in the fuse and ignite the fulminate of mercury. This fulminate detonates a primer of dry gun-cotton, and this, in turn, detonates the full charge of damp gun-cotton in the torpedo.

### SUBTERRANEAN MINES.

Closely related to submarine mines are subterranean mines, which have been used satisfactorily in land warfare, being sown in places over which the enemy might be expected to pass, especially in the approaches to a fort or other intrenched position. The mines may be fitted with percussion fuses or with electrical connections, such that they can be exploded by an operator within the intrenchments, whenever the enemy arrives at the proper place. The result of the explosion of one of these mines in the midst of an advancing regiment cannot be pictured with comfort. The present system, in which troops are kept in open or skirmish line, rather than closed in mass, will probably result in a larger number of mines, each mine comparatively small.

### TORPEDOES.

In my previous paper much space was given to the spar torpedo, in which the explosive was carried upon the end of a spar, and was designed to be shoved against the under-water side of a hostile ship. Nothing need now be said about it, except that it is becoming rapidly a thing of the past; perhaps not rapidly enough.

With the auto-mobile torpedoes, like the Lay, in which the directing power, though not the motive power, is electricity, not very much change has come to pass; the torpedo occasionally is exhibited, and shows itself capable of doing good service under certain conditions.

In torpedoes in which the motive power as well as the directing power is electricity, considerable improvement can be seen, notably in the Sims-Edison and the Halpine-Savage. The principal difference between these two types resides in the fact that the power for the Sims-Edison is transmitted to it along the wire, while in the Halpine torpedo it is carried on board in storage batteries. The Halpine torpedo has additional features also, by means of which a projectile can be discharged from the bow, when it strikes any resisting object, such as the underwater body of a ship, or the projecting net, and by which this act of discharge reverses the propelling motor, thus causing the torpedo to back away from danger. The projectile, meanwhile, keeps swiftly on its way, and when it reaches a certain distance, *i. e.*, the length of a small chain connecting it to the torpedo, it is exploded. The field for torpedoes of this class seems to be the coast, harbors and rivers of a country, rather than the open sea.

In the practical service of the far-famed Whitehead torpedo, of which there are probably more in existence than

*A lecture by Lieut. BRADLEY A. FISKE, U. S. N., before the Franklin Institute, published in *The Journal of the Franklin Institute* for September.

of all others combined, it has been found that electricity gives a more precise control of the time of starting than any other means.

In the Howell torpedo, which is rapidly coming into prominence as the superior of the Whitehead, it is now contemplated to employ electric motors to produce the rapid revolution of the fly-wheel, which stores up the energy needed for propulsion.

MILITARY TELEGRAPH SERVICE.

In armies, aside from submarine and subterranean mining, the principal use of electricity is in the military telegraph service, and its importance there can hardly be overestimated. One great cause for the suddenness and completeness of the German victory in 1870 was the rapid mobilization of the Prussian Army, and its appearance, on the frontier, ready for battle. Now the splendid efficiency of the telegraph service in the hands of the military authorities made this possible. Nothing is more essential in warfare than dispatch and precision in moving the enormous bodies of men, of which armies are composed, with all their ammunition, equipments, supplies and numberless accessories. To move a quarter of a million of men to the frontier in one day means a great deal; and to manœuvre so large a body in the field, with such precision and rapidity that no one division shall have to wait for any other division, simply cannot be done without electricity. In military countries, and in all countries during war time, the regular telegraph lines are pressed into government service; but in the field these lines must be supplemented by the military telegraph proper. This is a separate organization, with special duties and equipments. Carefully designed wagons carry wires on reels, batteries, telegraph instruments, telephones, etc. Some of the wire is insulated, and is run rapidly along the ground, just as at a fire a hose is laid in a street from a rapidly moving hose-cart, some of the wire is bare, is intended to be put on hastily erected poles and on trees sheds, etc., or sometimes to be simply laid along the ground and used in connection with telephones, automatic circuit breakers and telegraphic keys. It is doubtless well known to all here that a telephone can be used in this way, even though it occasions a great waste of current, the telegraph key being manipulated in the ordinary way, and the automatic circuit breaker causing a loud sound in the telephone whenever the key is closed.

BALLOON OBSERVATIONS AND BALLOON SIGNALING.

As part of the military telegraph service, foreign armies have used balloon signaling considerably, and it will probably be an important factor in any future war. The movements of the enemy's forces can plainly be seen from a captive balloon at a height of, say, 1,000 ft., and the result of the observations telephoned down to the officers stationed on the ground. Balloons have also been used in signaling to a distance, an incandescent lamp being suspended beneath, which is made to glow at intervals and to thus signal letters and words in accordance with a preconcerted code.

As regards balloon propulsion, many experiments have been made, notably by TISSANDIER, who has accomplished wonders in propelling ballons against the wind, using small storage batteries and very light electric motors. Nevertheless, it cannot be said that the advent of balloon propulsion can be seen anywhere upon the horizon of the future; while, at the same time, the rapid increase of speed and facility in travel, telegraphy, telephony and mail communication, is daily rendering ballooning more and more unnecessary.

INSPECTION OF GUNS.

Among the minor military applications of electricity, there are in use all over the world a number of such devices as small incandescent lamps arranged to illumine the bores of guns, velocimeters, etc., for inspection.

VELOCIMETERS.

Velocimeters are of countless forms, but in all, some kind of time-measuring instrument is set in motion by a projectile striking one wire and stopped by the projectile striking another wire. The distance between the wires being known, the interval of time recorded is a measure of the velocity of the projectile while passing over that distance. In the same category is an electric chimograph, which records the exact instant a projectile starts and when it leaves the bore.

ELECTRIC CONTROL OF WAR SHIPS.

But it is in the modern war ship that we find electricity in its broadest field. In no other equal space can there anywhere be found so many, so various and so important forms of apparatus. The reason is apparent. The modern war ship is the most intricate, tremendous and powerful machine existing. The fate of a nation may, at a crisis, depend upon a single shot. Everything must be done to contribute to her speed, endurance and effectiveness. She must be under quick and absolute control at all instants. She must respond at once to the will of her captain, and her whole strength and power must be his, as though it were a part of him. Ensconced in his conning tower, he must be the brain of the gigantic body. Electric wires must, like nerves, convey instant tidings to him from her innermost recesses, and electric wires flash back from him the inevitable command. The enemy being in sight, the captain must, at each instant, know her exact distance and direction in order that he may lay his guns accordingly. These guns must not be apart from him, under only general control, but he must have them absolutely in his hand, and make them do his will. This does not mean that he must concern himself with details or himself press the key that fires the guns; his gunnery officer, a specialist, can do that; but the gunnery officer must have the proper apparatus under his personal direction, and fire the guns with the precision given him by his skill and experience, and the captain must personally direct the gunnery officer. As for the guns, they must always be bearing on the enemy, and always correctly elevated for the distance, so that they will be ready to fire as soon as they are loaded; no delay can be tolerated.

*(To be Continued.)*

## Baltimore & Eastern Shore R. R.

The opening for traffic of the Baltimore & Eastern Shore R. R., recently noted, brings to a completion a local enterprise of considerable importance. The Baltimore & Eastern Shore R. R. Co. was chartered in 1886 to build a line of railway from Salisbury, Md., to a point on the eastern shore of Chesapeake Bay. In 1888 the company secured by purchase the Wicomico & Pocomoke R. R., running from Ocean City to Salisbury, 31 miles, and in 1889 construction was commenced on the main division.

The contractors were Godeffroy & Howe, of New York City, and under their direction work was rapidly pushed ahead, 10.8 miles of the road being completed during the year. Work was continued during the winter of 1890 and proceeded without interruption until the completion of the line, as originally projected. In July, 1890, the Annapolis & Bay Ridge R. R. was consolidated with the Baltimore & Eastern Shore, thus completing a line from

Map of Baltimore & Eastern Shore R. R.

Baltimore to Ocean City, 108 miles long, including an 11-mile transfer across the bay.

The division from Salisbury to the eastern shore of the bay, 57 miles long, was the only new construction. The work was generally light, the route being through an almost level country, the only heavy work being the bridges across the Choptank and Nanticoke rivers.

The road runs through a section of the State of Maryland devoted almost entirely to fruit growing and truck farming, and from which large quantities of fruit and vegetables are shipped to the surrounding cities of Philadelphia, Baltimore, Washington and smaller places. This peninsular trade with Washington and Baltimore has hitherto been carried on by means of steamers. It is now believed that the new road will obtain a large portion of this traffic and will rapidly build up a large additional traffic in sections having little trade now on account of the hitherto inadequate facilities for transporting their products to market. Connection is had with railways to the north, south and west at Baltimore and the road is intersected at several points by railways running north and south through the peninsula and furnishing an outlet to Philadelphia.

## The Preservation of Cross-Ties.

At the convention of the American Roadmasters' Association at Detroit last week, the committee on "Best Methods for Preserving Cross-Ties," submitted in their report a paper prepared by H. W. REED, Roadmaster of the Savannah, Florida & Western Ry. The paper was principally compiled from the report of a committee of the American Society of Civil Engineers made in 1885. As it gives in small space some of the chief points relating to timber preservation we give the following abstract:

It has been determined by repeated experiments that a thorough preservative of timber must not only contains chemical antiseptics for the coagulation of albumen, and have power as an insecticide, but must also exclude the atmosphere by filling the pores of the wood and surrounding the fibres with a substance impenetrable by the atmosphere. The theory that decay is due to atmospheric germs finds support in the fact that timber constantly under water does not decay; that which is constantly dry decays slowly, due probably to the coagulation of the albumen. Timber thoroughly seasoned by heat decays less rapidly than that treated by any other mechanical process. This is due to the coagulation of the albumen. Timber subject to alternate dryness and moisture decays most rapidly, owing, doubtless, to the softening and drying of the albuminous substances of the timber, thus rendering it more certain of attack by atmospheric germs.

Experiments with various processes of timber preservation have been conducted for centuries; but proprietary processes, usually consisting in the applications of certain antiseptics, have only developed during the last century, and principally within the railway era. Over one hundred patents have been issued within the United States, on timber preserving processes, most of which have proved failures on trial.

There are four situations in which timber may be placed which require different properties in the preservatives used. These situations are:

1. Immersion in sea water where it is subject to attack by the *teredo navalis*, and other sea worms.
2. Exposure to alternate moisture and dryness.
3. Exposure to the atmosphere only.
4. Exposure to strains.

Of the many preservative agents employed, those of value may be resolved into these classes: 1. Those derived from the distillation at high temperature of vegetable tars, albuminous and oily substances. 2. Those having a mineral acid as a base. 3. Any modification or combination of the two foregoing classes. Under the first head we have creosote as the only known preservative capable of resisting for an indefinite time the attacks of the teredo and atmospheric germs. This preservative leaves the timber in its normal condition as to strength. Thus creosoting is the only process known that successfully meets *all* the requirements of a wood preservative Only one element, the expense, militates against it. The value of creosote as a wood preservative is attributed by an eminent English authority, SAMUEL B. BOULTON, to the presence of acridine, an intensely acrid and pungent substance, forming one of the alkaloid bases of creosote oil and of napthaline, a substance less volatile than the tar acids which give the thick yellow appearance to the outside of newly creosoted timber, afterward becoming darker by exposure to the atmosphere. These, Mr. BOULTON, and other English scientists agree, are more powerful as permanent preservatives than the tar acids, which, while they are more active at first in coagulating the albumen, are exceeding unstable, passing entirely away in a comparatively short time. Acridine and napthaline, however, remain to permanently protect the wood, both chemically and mechanically, against the destructive attacks of atmospheric germs. These substances are among the residual products after distillation of wood tar at a temperature exceeding 450° Fah.

There is some question as to the comparative value of coal tar creosote. We have been unable to learn of any experiments with the latte of sufficient duration to demonstrate its comparative value; but we are of the opinion that by observing the same rules in the use of the products obtained by distillation at high temperature we will arrive at about the same results as in the use of a dead oil. If this proves to be the case, we can expect to purchase creosote oil at much less than the present rate of one cent per pound.

Under the second head we have the processes of: Kyanizing, treatment with corrosive sublimate; Burnettizing, the use of the chloride of zinc; Boucherie, the use of sulphate of copper. The patents on all these materials as applied to preserving timber have long since expired; thus we are at liberty to use any of them without royalty, provided we do not infringe upon various patented methods of their application.

Kyanizing was patented in 1832. The earliest recorded experiment was made in 1838 on chestnut ties, which were in good condition 11 years afterward. From that time on the American Society of Civil Engineers possesses authentic records of 16 different experiments with this process, about one-half of which were successful, preserving the wood for about twenty years.

The salts were introduced by steeping the timber in solutions 3% strong by weight. From four to five pounds of the salt per 1,000 ft., B. M., is considered sufficient. With the salt at 50 cents per pound the cost of Kyanizing is estimated at from 25 cents to 32 cents per tie. This process has been recommended for timber entirely protected from moisture (other than atmospheric moisture), but owing to the fact that corrosive sublimate is partially volatile at ordinary temperatures, is readily liquefied and is a deadly poison, invariably injuring the workmen engaged in preparing it, and that it is said to render the timber brittle, it is generally considered objectionable as a preservative for ordinary use.

Next in point of age is Burnettizing. Chloride of zinc, when used in large quantities, as in a solution over 3% strong, seriously injures the elasticity and strength of wood. The proper strength of the solution is 1.91 to 2%. Another objection is that chloride of zinc is easily soluble in water, and, therefore, on account of these two objections, it is manifestly unfit for bridge timber. Applied to cross-ties, it serves a better purpose, as in that situation it has no transverse strain to resist and is not readily washed out; but an objection occurs even here, as the ties are liable to crack and split under the rays of the sun. The cost of this system is from 15 to 25 cents per tie. A report of a committee to the American Society of Civil Engineers, June, 1885, recommends Burnettizing as the best method for preserving cross-ties.

The Boucherie process, which employs sulphate of copper, has been tried extensively both in this country and in Europe. This process is a failure as against the teredo or other sea worms, and renders the wood very brittle; but as a protection to timber exposed to the atmosphere, it seems to have been successful in a few cases, and a particular failure in others. The process of application consists in forcing the solution (made 1% strong) into the large end of the timber while green by means of hydraulic pressure. As sulphate of copper has a destructive influence on iron, it would not be practicable to apply it in enclosed iron cylinders, and if copper cylinders were used, the plant would be more expensive than the value of the process would warrant.

Under the third heading we will mention a modification of the Burnettizing process, which was patented by Mr. WELLHOUSE, and has since been extensively employed at several places, notably on the Atchison, Topeka & Santa Fe R. R. This process consists, first, of an application of chloride of zinc with a little glue added, followed by a solution of tannin, which, it is claimed, "forms, upon coming in contact with the glue, small pellicles or films of insoluble artificial leather, which plug up the mouths of the sap ducts so as to prevent the zinc from washing out." This process has been employed only since 1879, and its merits are yet to be demonstrated.

While we find that creosoting is the most perfect, it is at the same time the most expensive method of timber preservation, and consequently it becomes desirable to form such a combination as will cheapen the process without decreasing the efficiency. This, we believe, may be done for cross ties by employing sulphate of zinc (Burnettizing), which readily seeks the center or heart of timber, and does not readily return to the surface again, as the first material to be injected, and next to inject creosote as an outer covering or protection. By this means we will obtain a valuable result at minimum cost. The creosote will overcome the tendency of the sulphate of zinc to wash out, or volatilize, and will also neutralize the tendency of the timber to surface crack, as when the zinc alone is used, while the zinc will thoroughly protect the interior of the timber. Just how much the cost of creosoting can be reduced by this process only actual experiment can determine. It has been shown that Burnettized timber rots first on the outside and creosoted timber begins to decay on the inside. Thus the combination should be more perfect than either one alone.

In all works on the subject we find it insisted that open grained and thoroughly seasoned timber alone should be used for the reason that such timber absorbs the preservative solution after the sap is partially removed by seasoning.

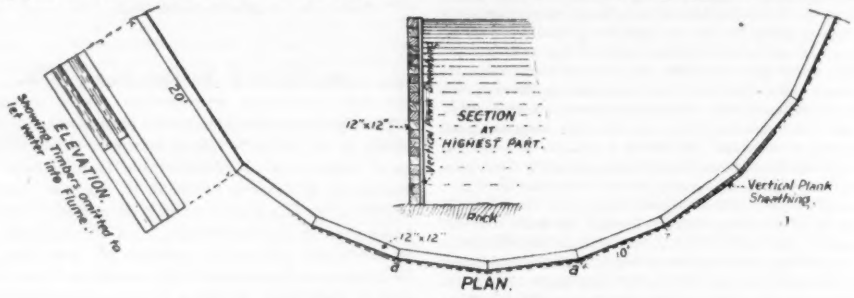
Many processes of applying preservative agents have been resorted to, from the ordinary paint brush through the various stages of steeping, vital suction and application by hydraulic pressure, to the more perfect means of exhaust and pressure within a closed iron cylinder. This latter method excludes sulphate of copper and corrosive sublimate, which have a deleterious effect on iron. Thus Kyanizing has to be carried on by the steeping process, the timber being placed in vats or tanks, thus rendering this process very tedious. Sulphate of zinc and creosote may be successfully applied in a closed cylinder.

This process consists essentially in an iron cylinder with a door at one or both ends, and a track running into or through it for the handling of timber. The doors may be closed air tight, and the cylinder is connected with a tank holding creosote oil (or other preservative) and with exhaust and pressure pumps.

After the timber is placed inside and the doors are closed tight the air is first exhausted and the sap drawn off, then the creosote is admitted, and finally a pressure is applied to force the oil into the timber. This process is elaborated and improved upon in various ways. By steaming the wood three objects are gained: first, the pores are more thoroughly opened and the sap is more thoroughly withdrawn; second, the fibres of the wood are preserved against destructive action by the high temperature of the creosote admitted (which temperature is essential to thorough saturation, as creosote at a temperature of 125° and under is exceedingly sluggish and will not enter the wood thoroughly); and third, the steaming coagulates the albumen. The steaming is also valuable in the case of sulphate of zinc, but the heating of the zinc is unnecessary and undesirable.

## A Very Bold Arch Dam.

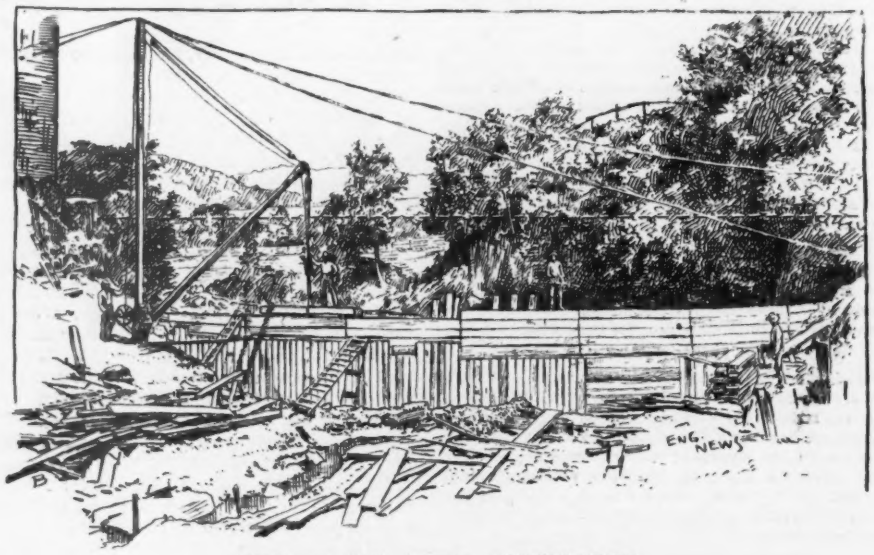
We are indebted to Prof. MALVERD A. HOWE, now of the Rose Polytechnic Institute, for the accompanying sketches and details of perhaps the most extraordinary engineering structure which ignorance ever projected and had even momentary success with, viz., a nearly semicircular timber arch dam, 25 ft. high at the deepest point, built of a single layer of 12 × 12 in. hemlock sticks, 10 ft. long, simply piled one above the other and drift-bolted together (with 3 bolts per stick); and butted together voussoir-fashion horizontally, so as to form a rude polygonal arch 12 ins. thick, which was the sole reliance for strength, the "voussoirs" of this arch being each 10 ft. long by 25 ft. or less high, and 1 ft. thick, and chamfered off at the end to the right angle to give a radial joint. There was no attempt to build the structure into a solid mass (or, rather, sheet) by breaking joints of the timbers. In fact, particular pains were taken not to do so; nor were the "voussoir joints" fastened together by spiking or by a vertical binding stick. The only additional part to the dam besides these 12 × 12 sticks was an interior vertical layer of 3-in. plank, cut in 8-ft. lengths and fastened with 3 or 4 spikes each, to give tightness and what little further strength they might. With this planking also breaking joints was carefully avoided.




ARCH DAM AT NORTHFIED, VT.

Our view (from a photograph) shows the dam in process of construction at a little more than half its final height, which latter is indicated by a dotted line on the cut. The photograph shows more clearly than we can in an engraving that the timber was all extremely rough, nearly half of the voussoir sticks showing marks of the bark or of splintering. The spillway was to the left of the view, and was obtained, with that neglect of structural precautions which runs through the whole structure, by simply omitting the "skewback" stick for two of the layers of timber (the second and fourth from the top) thus leaving those courses of the arch with a bearing on only one abutment, and leaving two openings 10 ft. by 12 ins. each for a spillway to the mill-race. The lower of these openings, we presume, was provided with a gate for closing it, as the normal flow of the stream did not nearly fill one of the openings.

This precious structure was erected this summer at Northfield, Vt., and carried away by high water Aug. 27 last, but not until it had stood seven or eight days and been filled to the brim and drawn off again twice in that period, without failure, thus proving what great strains material may sometimes be subjected to with success, and what loose construction may sometimes hold together for a time. The radius of the polygonal arch was about 40 ft., as nearly as we can determine, and it consisted of eight sides of 10 ft. each and one of 20 ft., making it 100 ft. long on the crest in all. No engineer was employed, we need hardly say, and the total cost of the structure was about $1,400. The dam rested on solid rock throughout.




VIEW OF DAM UNDER CONSTRUCTION.

(The broken line above dam indicates full height to which it was built).

## Legal Decisions of Interest to Engineers.

*Partner's Power to Bind Firm.*—The assignee of a firm of contractors sued the city for a balance due on a paving contract, the city claimed to be merely a stakeholder, holding the balance till the claim of a bank under a prior assignment by one of the parties as security without the knowledge of his co-partner, should be decided. This was not a trading partnership, and in absence of proof of express power to bind his partner, such partner had no power to pledge the firm's assets in security. (Harris v. Mayor of Baltimore, Court of Appeals of Maryland, 20 At. Rep., 111.)

*Condemnation Proceedings.*—A railway company cannot condemn land for the purposes of its road, and for the alteration of a public street, under the charter giving it the right to condemn land "for the construction and maintenance" of its road. (Chicago & N. W. Ry. Co. v. Galt, Supreme Court of Illinois, 24 N. E. Rep., 674.)

*Crushing of Brakeman's Fingers in Coupling Cars.*—A brakeman had to go between the cars to knock out the link pin, as the draw-heads were so defective that it could not be done with a stick as was required by the rules. The engineer backed up without waiting for the signal, and the brakeman's fingers were crushed. He is entitled to recover for the injury so received. (Georgia Pac. Ry. Co. v. Rigden, Supreme Court of Georgia, 11 S. E. Rep., 603.)

*Defective Brake-Chain.*—One of the links of a brake-chain was joined with a smooth "cold shut" instead of being properly welded, and the car inspector, whose duty it was to inspect the cars, might have discovered the defect upon a careful examinption. The car-inspector and a brakeman are not fellow-servants, and the company is liable for using a chain in which existed this visible defect, by means of which a brakeman was killed. (Morton v. Detroit B. C. & A. Ry. Co., Supreme Court of Michigan, 46 N. W. Rep., 111.)

## Floating Long Spans into Place.

[WITH INSET.]

We illustrate in the accompanying inset sheet the main features of the interesting feat accomplished on Aug. 23 last, of floating the great 523-ft. channel span of the Ohio Connecting Railway bridge over the Ohio River just below Pittsburg, Pa., and just above the Davis Island dam, which makes a still water pool of the river at this locality, barring the inevitable slow flow of the river, thus greatly facilitating the work. As we have already noted in prior descriptions, the entire operation was carried through in a few hours, without a hitch, the whole work reflecting great credit on the builders of the bridge, the well known Keystone Bridge Co., and its Chief Engineer, Mr. C. L. STROBEL.

The span which we illustrate is the largest span as yet handled in this way, anywhere in the world, and was most smoothly and perfectly accomplished. but the erection of bridges in this general manner, we need hardly say, is not by any means a novelty. Most of the earlier long span iron bridges having been erected in this way, a few notes of these earlier operations of the kind will be of interest for comparison.

The first of all structures of any size to be so handled, we believe, was the Conway tubular bridge, and the great Menai or Britannia tubular bridge (1845-8), immediately succeeded it, where four successive tubes 470 ft. long, and weighing 1,587 tons each, were floated on pontoons and carried to the piers; and under circumstances of extreme difficulty, for in the narrow Menai Straits the tidal currents have a high velocity, some 9 miles per hour, being slack for a very short time, and the tide has a very great rise and fall, some 15 or 16 ft., we believe, it having been 21 ft. at the neighboring Conway bridge, which was designed and erected by the same engineer, ROBERT STEPHENSON, for the same railway.

The Conway Tubular bridge was of 400 ft. span and weighed as lifted about 2,000 tons, which was carried on 6 pontoons 98 × 25 × 8 ft., costing $7,500 each. The floating began on March 6, 1848, and was not completed till March 11; while it was not till a month later that the spans were elevated to their permanent level, 18 ft. above the water. At this date the piers of the Menai Bridge were just approaching completion, and the two great works were practically one and went on simultaneously.

Thus it will be seen that these first of all instances of floating complete spans into place were perhaps the most difficult of all. Their enormous weight, the swift and changeable current, the great rise of tide, the partial exposure to waves of the sea, and the lift of 100 ft. at the Menai, which had to be made after the tubes were in place, the comparatively imperfect plant of that day; all made a combination of difficulties to be conquered, which have never since been exceeded in any instance of the kind. The great Saltash Bridge (445 ft. clear span) on the Great Western Railway, was also handled in this way, in 1859, as have a number of other great bridges of English design since, in Europe and India.

Among the latest instances have been the "Jubilee Bridge" over the Hoogly River in India (which was floated out at one end only, however, the other end resting on fixed spans) the spans being 1,465 tons in weight and 420 ft. long, and finished in 1886, the 2 pontoons used to carry one end being 225×26½×9 ft.; 13 spans of the new Tay Bridge (ENG. NEWS, Aug. 6, 1887) 11 of 245 ft. length, and 2 of 227 ft.; the Hawkesbury bridge in Australia (ENG. NEWS, Jan. 5, 1889), where a single pontoon 335 × 61 × 10 ft. was used to float the 416 ft. span, weighing over 800 tons, into position; some 250 ft. spans erected last fall at Jacksonville, Fla., by the same Keystone Bridge Co., which has done this last most creditable work; and finally the Coteau Bridge over the St. Lawrence River (ENG. NEWS, April 12, 1890) where spans of 217 to 223 ft. were so floated into position.

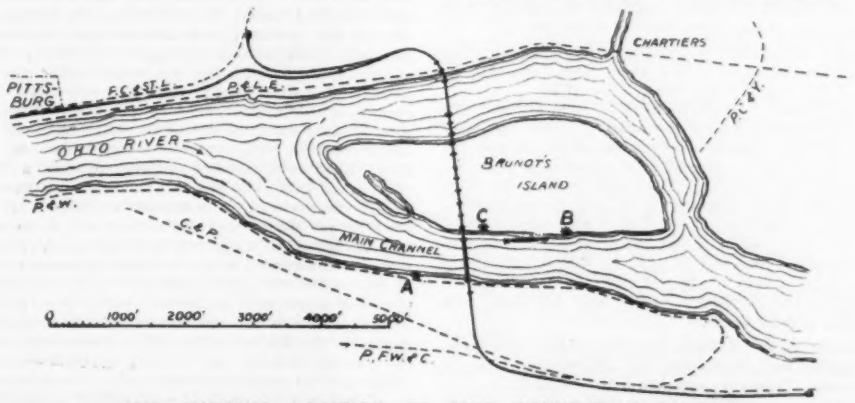
The total weight of the 523 ft. span which was floated into place was 915 tons, as nearly as may be, its width 25 ft., and its extreme depth 65 ft. The bottom chord is 75 ft. in the clear above mean water level.

This entire weight was carried on 9 barges of standard Ohio River coal barge type, so that their cost for this work was merely a rental charge. They were each 130 ft. × 26 ft. × 8 ft. deep. Their width was a shade under the length of a half panel of the bridge, which had 10 panels in all. When under the span, consequently, they supported 9 half-panels directly, leaving two half-panels to project cantilever-fashion beyond them, and 9 half-panels to be included in the 8 intermediate spaces. This was effected by making the space between two of the barges near the middle of the span a full panel long, all the other spaces being only a half-panel.

The 10 panels were each 52.3 ft. long, and the trestle for erection consisted of 21 bents spaced 26.15 ft. apart between centers, each bent supporting a half panel, as shown in View *A*. The 5-pile bents under this trestle, however, were not spaced exactly equidistant, but grouped somewhat in pairs, as shown in View *C*, at such distances as to permit the 9 barges to be floated in between them, each of these barges carrying a low trestle, as shown at the right of View *C*, of such dimensions as to bring the caps of the low trestles exactly under the sills of the high trestle, or 26.3 ft. between centers. In View *A* the barges are so submerged as to be all but invisible behind the row of barges along the foreground, but their general arrangement can be readily seen.

The fixed shore trestle was erected at about the point shown on the accompanying map, or some 300 ft. in the clear below the bridge pier. The map also shows by letters the points of view from which our three views were taken. After every thing was complete, the 9 barges, partially sunk by admitting water, were floated into position between the pile bents. The water was then pumped out by steam pumps on 3 tugs. At 8.50 A.M. on the morning of Aug. 19 the span was lifted clear and floated on the barges; at 11.15 it had been towed out parallel with the shore, and had been stopped to insert further tracing at the back between the barges (that in front having been in place before they moved); at 7 P.M. the south end of the span was in position; 20 minutes later the north end was in position, and plugs were removed from bottom of the barges, allowing the truss to sink down toward its seat. When within about 9 ins. of its place work was stopped, and not until the next morning was the span finally placed in position. The span was guided to its precise position as it sank, by bars inserted in the anchor bolt holes.

The shore trestle consisted of 5-pile bents 16 ft. high above the water, capped by the main trestle above noted which was 57 ft. high, making 73 ft. in all, the base of rail being 70.7 ft. above the water.




MAP SHOWING LOCATION OF OHIO CONNECTING RAILWAY.

A, B and C are points from which views were taken. The black line between B and C shows where span was erected.

The bents were of 12 × 12 timber throughout except 12 × 14 in. caps and sills. Each trestle bent consisted of one post and 4 batter posts, braced transversely by the usual 3 × 10 in. sway bracing, and longitudinally by plank girts and iron tie-rods arranged as shown in the cut. To obtain the necessary splay for floating on the barges properly the outer posts were very much battered, nearly 3 ins. per foot, the intermediates having half that batter. This made the main trestle 80 ft. wide at the bottom while only 32 ft. at the top.

Between the main trestle and the pile trestle were placed light 20-in. I-beams in pairs, 5 pairs per barge, spanning each alternate space, as shown in our views, in such manner that the beams should extend across each barge when floated, over the low trestles erected on them, as shown in View C.

As usual in such operations the moving of the great mass was effected with extreme caution, entirely by lines operated by hoisting engines on two barges passing through blocks made fast to the shore or to piles driven in the water. The mass was carefully guyed and back-stayed, and no hitch of any movement occurred in the whole process. The mass was first moved out clear of the piling, then swung around through an angle of about 90°, and then moved up to place.

The barges were connected together by struts and longitudinal bracing in front before being floated out into the stream, and after they were clear of the piling were similarly braced behind. The chief reliance for rigidity was naturally the great mass of truss and trestling above. The trestling was so constructed that the greater part of the material as well as all the iron rods and I-beams, can be used over again, making the operation but slightly more expensive than if the span had been erected on fixed false-works.

For the following additional particulars received since the above was in type we are indebted to Mr. C. L. STROBEL, Chief Engineer of the Keystone Bridge Co.:

The lines were run to the piers and to both shores. On the island side they were attached to the piles upon which the false works originally rested.

On the afternoon of Aug. 18 everything was in readiness to begin the work of moving. All the barges had been inserted and the water had been pumped out of them, so that the I-beams were lifted off the pile caps. Blocking was placed between the I-beams and the caps of the piles and the structure held in this condition through the night.

On Tuesday morning, Aug. 19, at 8:50 A. M., the moving of the structure began. At 11:15 in the morning the structure, including boats, was clear of the piles. Two heavy rainstorms interfered with progress in the afternoon. There was, however, not very much wind.

All the towing was done by four hoisting engines on the two flat boats. These flat boats were fastened to the bows of three of the barges at each end. The work of moving was slow, owing to the many lines, the number of shifts that had to be made and the distance apart of the men.

At 5:30 P. M. the plugs were removed and the water was allowed to enter the barges. The span was about 26 ins. above the pier at the fixed end and about 24 ins. at the roller end.

At 8.20 P. M. the span was 10 ins. and 8 ins. clear of the piers at the respective ends. It was concluded to discontinue the work, so wooden blocking was put under for the night and the span made fast to the piers by means of lines. The structure remained in this condition (with the boats under the span) through the night.

At 7.30 the next morning the span had been lowered so as to rest entirely upon the piers. There was no difficulty experienced in the fit. Later in the day the boats with false works were removed from under the span and taken to the original position. The work of shortening up the false works was then begun.

As soon as the piles had been driven in the 416-ft. span the false works were to be floated down stream, around the point of the island, and towed into place in the other channel. They were then to be lowered on the piles and the boats removed The erection of this span was then to be done in the usual way.

Freshets in the Ohio River interfered with this work, as the level of the river was thereby raised above pool stage, and the Davis Island Dam was let down. Owing to this delay, this work could only recently be done. The false works are now resting on the piles in the 416-ft. span, and the work of raising this span will be begun in a few days.

While the work of moving the false works around the island was under way, a violent gale of wind sprang up. A steamboat was used to tow the structures, assisted by lines running to the shores. It was found that the steamboat would not hold the structure, unassisted; the barges were then allowed to drift against the shore, and the structure held in that position until the storm was over.

## The New Protected Cruiser.

The new protected cruiser, plans for which have just been completed at Washington, is to be one of the fastest and most powerful ships afloat, able to overtake the swiftest of Atlantic greyhounds. She is called a commerce destroyer, and her great speed will enable her to overhaul the fastest merchant vessels, and keep out of the way of the few heavily armored battle ships which she is not able to whip. To show her efficiency as compared with the best cruisers of other nations the following table has been prepared by the Bureau of Naval Construction:

| | Horse power..... | Speed, knots..... | Coal endurance. Coal that can be carried in bulk-heads, tons..... | Coal endurance. Distance that can be steamed at 10 knots without recoaling, knots ..... |
|---|---|---|---|---|
| The Commerce Destroyer (U. S.) ..... | 20,500 | 22.0 | 2,000 | 24,240 |
| The *Blake* (British) ..... | 20,000 | 22.0 | 1,500 | 15,000 |
| The *Dupuy de Lome* (French)..... | 14,000 | 20.0 | 700 | 4,000 |
| The *Piemonte* (Ital.)..... | 12,000 | 21 0 | 900 | 13,000 |
| The *Philadelphia* (U. S.).. | 10,000 | 19.7 | 900 | 12,000 |

The *Blake* is certainly the best cruiser the British navy can boast, and the *Dupuy de Lome* and *Piemonte* are likewise the best vessels of this class of their respective nations.

In appearance the new commerce destroyer will be as similar as possible to a merchant vessel, in order that she may come within range of her prey before her character is discovered. Her dimensions will be: Length, 400 ft.; breadth, 58 ft.; draught, 23 ft.; normal displacement, 7,300 tons; indicated HP. under forced draught, with 160 lbs. boiler pressure, 20,500. The armament will consist of four 6-in. rifles, eight 4-in. rapid fire guns, twelve 6-lb. and six 1-lb. rapid fire guns, two machine guns, one field gun and six torpedo tubes. The vessel will be protected by an armored deck, 4 ins. thick on the slopes and 2½ ins. on the flat. Between this deck and the gun deck will be coal bunkers and store-rooms. A compartment 5 ft. in width, lined with one of the patented materials for closing the holes made by a shot, will surround the sides of the vessel.

Steam will be furnished by 10 boilers carrying 160 lbs. pressure, 8 of which can be worked under forced draught on the closed fire room system. The vessel will be driven by three screws, the center one placed 15 ft. aft and 4½ ft. below the other two. An especial advantage of the triple screws for this vessel is that for ordinary cruising the center one can be run alone at the most economical speed, thus materially increasing the coal endurance of the vessel. The proposals for this vessel will be closed on Oct. 1.

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THE BRITISH IRON AND STEEL INSTITUTE, whose meeting in this city is to be one of the events of next month, is represented by over 170 members on the *Servia*, which sailed from Liverpool Sept. 20. Among these members are President Sir JAS. KITSON, and Past-President Sir ISAAC LOWTHIAN BELL. Among other recent arrivals at New York of distinguished English engineers are Sir WM. ARROL, head of the firm which built the Forth Bridge; Sir BENJAMIN BAKER, who is here on business connected with the Hudson River Tunnel, of which he is consulting engineer, and Mr. JAMES DREDGE, editor of *Engineering*.

## PERSONALS.

Mr. T. M. HURLBURT has been appointed Engineer of the East Side Water Co., East Portland, Ore.

Mr. W. GRANT WILSON has been appointed General Manager of the Philadelphia & Seashore R. R.

Mr. E. G. ALLEN has been appointed Superintendent of the Hudson Division of the New York Central R. R.

Assistant Engineer J. H. BAKER, U. S. N., died recently on board the U. S. steamer Swatara at Chefoo, Corea.

Mr. W. R. BUSENBARK has been appointed Assistant General Manager of the Chicago, St. Paul & Kansas City Ry.

Mr. E. D. BOLTON has been appointed Chief Engineer of the sewerage construction at White Plains and Tarrytown, N. Y.

Mr. A. MORDECAI has been appointed General Roadmaster of the Chicago & Erie R. R., succeeding Mr. CHAS. LEVINGS.

Mr. A. S. OSTRANDER has been appointed Superintendent of the Shore Line Division of the New York, New Haven & Hartford R. R.

Mr. W. J. HALLET has been appointed Assistant Master Mechanic of the Cincinnati Division, Chesapeake & Ohio Ry., vice Mr. W. J. MCKEE resigned.

Mr. R. T. SCOWDEN has resigned his position as City Engineer of Louisville, Ky., in order to become the Engineer of the Chicago, Ill., Refrigerator Co.

Mr. J. R. TAYLOR, late General Manager of the Rome & Decatur R. R., has been appointed Assistant General Manager of the Knoxville, Cumberland Gap & Louisville R. R.

Mr. J. V. PATTON has assumed the duties of Gen. Manager of the Pittsburg & Western R. R. Mr. ALFRED WALTERS, Gen. Superintendent of the Baltimore & Ohio system, has taken charge of the Pittsburg Division and will manage it until the vacancy caused by Mr. PATTON'S resignation is filled.

## NEW PUBLICATIONS.

—*Biological Examination of Potable Water.* By GEO. W. RAFTER. Reprinted from the Proceedings of the Rochester, N. Y., Academy of Science. 1890. Pamph., pp. 10; four cuts and two plates.

This little pamphlet describes the methods employed by the author in the biological examination of water, and the cuts show the apparatus which he uses. One of the plates illustrates the means employed in counting cells, and the other gives a blank form of record sheet.

—*Poor's Hand Book of Investment Securities*, a supplement to Poor's Manual of Railroads. New York, 1890. H. V. & H. W. Poor. Paper, 8vo, 3 5 pp. $1.50.

The editions of Poor's Manual for 1886, 1887 and 1888 acontined a table showing the range of stock and bond values in the leading stock exchanges of the country. In 1889 this information was omitted on account of the increase in size of the book. This year this matter, with considerable other information of interest to bankers, brokers and investors, is published in a separate volume. The additional matter shows the dividends paid by railway companies from 1882 to date, the time of holding annual meetings, date of close of fiscal years, and opening and closing books, transfer agents, and full data with regard to railway bonds.

—*Handy Lists of Technical Literature: Part III.* Engineering and Mechanics, etc Milwaukee: Heise & Haferkorn. Paper, 8vo.: pp. 168; with key; $2.75.

The main list, containing over 2,000 works, is divided into four parts; (1) books published between 1880 and 1889; 2) books published before 1880; (3) books published during 1889 and 1890; and (4) newspapers, periodicals, etc., relating to engineering. This division according to date of publication is rather unfortunate, since careless users will most likely refer only to the first part, while the second and third contain many important works.

Parts second and third are arranged by the names of the authors only. Part first contains authors' names, titles of books and special subjects, such as water-works, railways, sewerage, etc. The names of authors and book titles are fairly complete, although such important recent works as Baker's "Masonry Construction," "The Manual of American Water-works," Cooper's "American Railroad Bridges," Gould's "Hydraulic Formulæ," Herschel and North's "Roadmaking," etc., do not appear; but the number of special references is quite inadequate, and by this fault the publication misses a chance for much usefulness. A large number of the persons using the list will naturally be those who are not familiar with the names of the writers or of the books on the subjects into which they are inquiring, and who consequently must depend on special references or else go through the whole list to find what they want. But as the only work of its kind, the book fills a void fairly well.

—*An American Geological Railway Guide*, giving the Geological Formation at every Railway Station with Altitudes above Mean Tide-Water, Notes on Interesting Places on the Routes, and a Description of Each of the Formations By JAS. R. MACFARLANE, Ph.D., with the Co-operation of the State Geologists and other Scientific Gentlemen. 2d ed., revised and enlarged by JAS. R. MACFARLANE. New York: D. Appleton & Co. 8vo., pp. 426. $2.50.

The first edition of this work, which is quite unique of its kind, and a very good kind, was published so long ago as 1878. Such a work naturally invites continual revision and extension, and the present revision extends the Guide proper from 158 to 370 pages. The altitudes are also a new and highly important addition to this work, making it of value to many others besides geologists. We know of no other publication in which the elevations of so many different points in the United States, Canada and Mexico can be at once ascertained. Their compilation must have involved no small amount of labor. How accurately this part of the work has been done we cannot say. It is a part of it in which very numerous errors may easily exist; but we detect no signs of error on cursory inspection, and the author is entitled to the presumption of substantial accuracy until evidence appears to the contrary. The absence of all notes as to the conflicting records of the elevation of many places makes it impossible to suppose that great precision in these elevations was attempted, nor was it necessary for the particular purpose of the volume.

The volume opens with 50 pages of general description of the formations of the continent, all the remainder being occupied with the railway tabulations, arranged by States in geographical order, but without separating the several parts of distinct systems which extend into several States. Almost every station is given with the elevation and formation at each, in addition to which an average of nearly half of each page is occupied with fine type notes of the special features of interest, such as mines, prehistoric remains, etc., in the vicinity of each station. Separate general summaries of State geologies are also given for many of the States and for Canada and Mexico, chiefly by the hands of State Geologists. These with frequent references to publications containing fuller information would seem to make the work indispensable to professional geologists, and a most valuable work of reference for any one interested in geology, especially if proposing a long tour.

—*Practical Marine Surveying.* By Harry Phelps, Ensign, U. S. N., New York: John Wiley & Sons, 8vo., pp. 217; 57 cuts and folding plate; $2 50.

In many important respects the practice of marine surveying differs from that of land surveying; so much so, that the expert in one is likely to cut but a poor figure if suddenly called on to do the other. Marine surveying, moreover, is largely in the hands of the government officials in this country, so that its practice is confined to quite a limited class. It is therefore not unnatural to find it announced that the present volume was compiled primarily to fill the need for a text book suitable for use at the Naval Academy, and we presume that the comparatively small number of engineers who have marine surveying to do will prevent it having a large circulation outside of the government staff of army, navy and civil officers charged with its various surveys; but any engineer is liable to be called on suddenly to make a marine survey, and those who are will find this work useful indeed, if they have it. It is eminently practical. It bears the marks of having been prepared by one whose knowledge of the subject is not from books alone, but who knows from experience just what are the points which need full discussion and what may be passed over. No time or space is wasted on geometrical preliminaries, nor on problems or methods which are common to all kinds of surveying, except to the limited extent which is necessary to make the treatise complete in itself. It is, therefore, a work which we can cordially recommend as about the best on its subject, which is confined to surveys of moderate size, as those of a harbor or short stretch of coast, without aiming to cover at all all the refinements of continental surveys, or even those extending over hundreds of miles, although these, of course, are necessary for the complete survey of any coast or part thereof.

The work opens with short chapters on the instruments used, the construction of signals and the measurements of base lines, somewhat too much stress, perhaps, being laid on a very simple method (necessarily) for reducing a broken to a straight base line, which a limited knowledge of geometry might be supposed to make simple enough. Polyconic projection (which many makers of small scale railway maps would do well to know something about, as it is simple enough); the main triangulation, plotting, secondary or shore-line work, topography and the plane-table and soundings occupy the next five chapters. Sounding with wire is then discussed, perhaps a trifle too fully in proportion; and the keeping of the notes; determination of heights; tidal observations; astronomical work; magnetic observations and the making of running surveys occupy the remainder of the work, with the exception of a closing chapter on the transit and equal altitude instruments. As a whole, the work is a first rate text book for use in any school and an excellent practical manual.

—*The Chronicle Fire Tables for* 1890. New York. The Chronicle Co., Ltd. Cloth, 7 × 10 ins. pp. 305. Several diagrams and charts.

This volume is exactly what it purports to be, "a record of the fire loses in the United States by risks, States and causes during 1889, with exhibits of the monthly, annual and aggregate fire losses in the United States during 15 years (1875-1889), and much other interesting and valuable information." The aggregate fire loss and insurance loss in the United States for 15 years has been as follows, in *millions* of dollars:

| | | | | | |
|---|---|---|---|---|---|
| '75..... | 78.1 | 39.3 | '84..... | 110.0 | 69.7 |
| '76..... | 64.6 | 34.4 | '85..... | 102.8 | 57.4 |
| '77..... | 68.3 | 37.4 | '86..... | 104.9 | 60.5 |
| '78..... | 64.3 | 36.6 | '87..... | 120 3 | 69.7 |
| '79..... | 77.7 | 44.5 | '88..... | 110.9 | 63.9 |
| '80..... | 74.7 | 42.5 | '89 ..... | 123.1 | 73.7 |
| '81 ..... | 81.3 | 44.6 | | | |
| '82..... | 84.5 | 48.9 | Total..... | 1,365.6 | 768.9 |
| '83..... | 100.1 | 54 8 | Average.. | 91 0 | 51.3 |

The property lost by fire in 1889 is said to be greater than for any other year in our history, excepting, of

course, the years of the great Chicago and Boston fires. In 1889 there were 17,598 fires, not including those with a nominal loss, against 16,019 in 1888. The value of the property destroyed in 1889 was 123 millions, against 110.9 millions in 1888. The number of fires increased by 1,579, or about 9 per cent., and the loss 12.1 millions, or about 11 per cent. The greater ratio of increase in loss is due to the fact that there were several unusually large fires, 7 of which resulted in a total loss of about 27 millions.

The loss by the Seattle fire in June, 1889, was 6.6 millions, and by the Spokane Falls fire, about two months later, 4.8 millions. Thus the loss by two fires alone, was nearly 10 per cent. of the total loss for the year. The average property loss, per fire, in 1889, was $6,992, against $6,922 in 1888, and $7,285 in 1885. As would be expected, the loss is greatest during the first and last quarters of the year.

Of 6,223 fires in 1889 of known origin, nearly 23% were reported as incendiary. The loss from fires caused by defective flues was less than in previous years, probably largely on account of the mild winter, though it is hoped that there is now a slight tendency to a continual decrease in this class of fires.

Perhaps the most remarkable and interesting figures in the book are those relating to fires reported as caused by electric wires and lights, which may be compared with the total property loss, as follows:

| Year. | Number of risks burned. | Property losses from electric causes. | Total property losses. |
|---|---|---|---|
| 1886..... | 29 | $460,250 | $104,924,750 |
| 1887..... | 66 | 681,930 | 120,283,055 |
| 1888..... | 91 | 1,587,213 | 110,885,665 |
| 1889..... | 357 | 5,533,820 | 123,046,833 |

More than half of the loss in 1889, or over 3.85 millions, is attributed to the Boston fire, without which the total loss from these causes would be but slightly more than in 1888.

A good word may well be spoken for the diagrams and charts, and especially for those showing for the various classes of risks the relative danger from fires starting on the premises and from exposure, or from internal and external fires. There are about 70 of these diagrams, showing for most risks a greater danger from fire starting within than without the buildings.

There is a diagram showing the movement of the fire loss in the United States for fifteen years, another showing for the five years, 1883-87, for 1888 and for 1889, the monthly fluctuations in numbers of incendiary fires, while a third diagram compares for the 11 years 1879-89, the number of fires and the number of business failures. For the five years 1883-87, the least average number of incendiary fires was in February, when there were but 103; the average number increased to 146 in April, fell to 118 in June, and rose to 225 in November. The diagram of failures and fires shows that in 7 out of 11 years the number of each has increased or decreased together, and in some years the lines on the diagram are nearly parallel. The exceptions are in 1881 and 1888, when the number of fires was less and of failures greater than in the preceding years, and in 1886 and 1887 when the reverse was true. Six charts of the United States show in black and white the relative amount of incendiarism in each State for each of the years 1884-89, inclusive. Both Nevada and West Virginia show over 50% of incendiarism in three years of the six, while Pennsylvania, California and Missouri show less than 20% for five years of the six. Incomplete reports from the Western States and the Territories could not always be avoided, and are indicated by an absence of color.

So far as we can judge the data in the "Fire Tables" are as complete as could reasonably be expected, considering the deplorable neglect of some of our municipalities to investigate and record the causes of fires and other information, and the fact that some of the insurance companies withhold information concerning fires causing them loss.

The subject of fire losses is of extreme importance to the country at large, as is shown by the enormous losses of the last 15 years, $1,365,000,000, an average of $91,000,000 a year. And in addition to the loss of property there is a loss of life, health and happiness, and often ruin in business, that cannot be estimated. These tables present to the public the magnitude and character of the loss and cannot fail to have an influence, and a strong one, towards lessening the amount of property annually converted into ashes.

An interesting and valuable addition to the book would be statistics regarding the number of lives lost at and deaths caused by fires. Also, if they could be secured, figures showing the relative number of fires in the large and small cities, and how the buildings burned, and the loss, compares with the number of buildings erected and their cost. Perhaps even more valuable than the above would be a comparison of fires in small villages having water-works with those in villages not having them.

—*Third Annual Message of* EDWIN H. FITLER, *Mayor of Philadelphia, with Annual Reports of* LOUIS WAGNER, *Director of Public Works, Philadelphia, and of the Chiefs of Bureaus for* 1889. Pamph., pp. 566, and several sheets of tables and diagrams.

The reports of the chiefs of bureaus contain much valuable detailed information relating to city ice boats, gas, highways, street cleaning, surveys and water-works, there being a division for each of these services. The data under each of these heads is very complete and will repay examination by those specially interested in any of the subjects. The first 121 pages of this volume, including the Mayor's message and Mr. WAGNER'S report, were published separately, and noticed in these columns some time ago, while Mr. WAGNER'S report is referred to editorially in this issue.

The growth of the gas works is shown in detail for each year from 1836 to 1889 by means of tables giving the number of public and private lights, the number and size of meters, the length and diameter of mains and finally the amount of gas manufactured and the amount consumed for public and private lighting. The amount of gas manufactured in 1836 was 6,481,300 cu. ft., against 3,151,156,000 cu. ft. in 1889. The total amount manufactured from 1836 to 1889, inclusive, has been 57,565,690,000 cu. ft., of which 9,199,447,337 was consumed by public lights, 40,038,924,149 by private lights, and 8,327,318,574 cu. ft. at offices, works, or was unaccounted for except by leakage. The loss by leakage was not recorded separately until 1884, but in the six years from 1884 to 1889, inclusive, the total amount unaccounted for except by leakage has been 17,777,800,000 cu. ft., or over 14% of the total output, which was 2,556,678,000 cu. ft. In 1889 the leakage was a little less than 11% of the total output, which shows a great saving over the average for the six years.

Prior to 1855 there had been built in Philadelphia 19.5 miles of branch and 18 of main sewers, or 37.5 miles in all. The cost of these sewers is not now known. Since 1855 there have been built 281.81 miles of branch sewers at a total cost of $3,755,164, of which $2,840,408, or about 75%, was paid by property owners in the shape of assessments, and the balance by general taxation. During the same period 48.59 miles of main sewers have been built at a total cost of $4,301,372, of which $242,295, or less than 6%, was met by assessments. The mileage of both branch and main sewers constructed since 1855 is 233.32, and the total cost $8,056,536, of which $3,082,703, or 38%, has been met by assessments.

The cost of the whole sewerage system, including that built before 1855, must have been in the vicinity of $9,000,000.

The data relating to the water-works are quite as complete and extensive as those for the other bureaus, but perhaps they apply more generally to the past fiscal year.

The total yearly and average daily pumpage is given for each station and for all stations for each year from 1854 to 1889, inclusive. The total average daily pumpage in 1854 was 11,700,000 galls., and in 1889, 116,490,000. A diagram in colors shows graphically, the pumpage for the year 1889 for each day and week and for each pumping station; also the rainfall in inches for each day in the year, the daily temperature of the air and water at the Fairmount pumping station, and the level of the flash-boards of the Fairmount dams.

A table of pumpage for the years 1880 to 1889, inclusive, shows that the average per capita consumption per diem has steadily increased from 68 galls. in 1880 to 110 in 1889, estimating the population at 1,050,000 in the latter year; also that the cost per million galls. raised 100 ft. high has decreased from $5.51 in 1880 to $3.87 in 1889.

Those interested in the number and kind of premises and appliances supplied with water will find a very complete analysis in the report. The total number of premises supplied is 170,911. There are 107,911 hydrants or faucets for general use, 105,979 baths in dwellings, 74,148 water closets in dwellings, 56,931 wash pans, and 44,079 sinks and basins in dwellings.

The volume closes with the report of hydrographic work done during the year, which is accompanied with numerous tables and diagrams showing the effect of the several storms on a number of streams. These data should be examined by all especially interested in the relation of rainfall to water supply.

—*Fourteenth Annual Report of the Executive Board of Rochester, N. Y., for the Year Ending April* 7, 1890. Pamph., pp. 228. Illustrated.

This volume is of unusual value because of the special reports it contains. The first of these is a report submitted in May, 1889, by JNO. T. FANNING and ALPHONSE FTELEY, Consulting Engineers, on an "Additional Water Supply." This report discusses the quantity of water required, capacity of the present conduit, possible sources for additional supply and the distribution system.

The expert's report is critically reviewed by J. NELSON TUBBS, who was for many years, and until recently, chief engineer of the water-works. Mr. TUBBS differed from the experts in that he recommended a combined gravity and pumping conduit, while they were in favor of an all gravity supply. Since the expert's report came from two such prominent hydraulic engineers as Messrs. FANNING and FTELEY, and was reviewed by Mr. TUBBS, engineer for the original works, who differs from them in some particulars, we have here some extremely interesting and valuable matter, which will repay examination by all interested.

Another noteworthy special report in this volume is that of GEO. W. RAFTER and M. L. MALLORY, on "Endemic or Typhoid Fever at the Village of Springwater, N. Y., in October and November, 1889." The valley in which the village is located drains directly into Hemlock lake, from which a large part of the Rochester water supply is drawn. Typhoid fever broke out here in the fall of 1889, necessitating sanitary inspection on the part of Rochester to keep its supply from being contaminated from the village. The report of Messrs. RAFTER and MALLORY treats of the causes giving rise to typhoid fever, of the danger from contagion, and especially the chances of the disease being carried from the houses in the village of Springwater, through the creek of Hemlock lake, through the lake to the conduit, and then through some 30 miles of conduit, with two intermediate reservoirs to the city of Rochester. The conclusion seems to be that the disease might be carried to the city under certain conditions, but the records of the Health Board show that it was not in 1889. The report is accompanied by a topographical map of the village of Springwater, plates of photo-micrographs of typhoid bacilli, a profile of one of the streets, showing elevation of ground water, and a sketch showing the relation of privies to wells and different elevations of ground water on sloping ground. This report has been reprinted separately.

An index adds greatly to the value of this volume, and is especially appreciated because so rarely found in this class of publications.

—*Washington, the Sound State, and Its Chief City, Seattle.* Its Past History, Recent Progress, and Present Advanced Position. By J. W. DODGE, Secretary Chamber of Commerce. Pamph, pp. 48.

As a record of wonderful and healthful growth the record of Seattle is almost unsurpassed. We will not spoil the story by endeavoring to epitomize it. It is worth reading. But Seattle should be ashamed of that jealousy of its neighbor, Tacoma, which leads it to insist on calling Mt. Tacoma Mt. Rainier, and which led it to insist on the present confusing name of Washington for the State instead of that of Tacoma, which would have been so much more in keeping with the names of the other States.

—*Institution of Civil Engineers' Papers.*—"Barytes and Umber Mines and Refining Mills," by P. L. ADDISON; "The Calliope Graving Dock, Auckland, N. Z.," by J. H. SWAINSON; "Notes on a Short Method of Distributing Triangulation Errors," by A. E. WACKRILL; "The Deflection of Spiral Springs," by A. E. YOUNG; "Some Applications of Electricity in Engineering Workshops," by C. F. JENKIN; "The Design of Railway Stations and Yards," by R. M. PARKINSON; "The West Hallington Reservoir," by C. G. HENZELL. "Abstracts of Papers in Foreign Transactions and Periodicals." The fourth and fifth papers are by Students of the Institute.

## SOCIETY PROCEEDINGS.

**New England Railroad Club.**—The annual dinner of this organization was held at the United States Hotel, Boston, on Sept. 10. The club was entertained by musical and literary selections, and by a phonograph exhibition. President Geo. Richards introduced as the after dinner speakers Hon. Harvey N. Shepard and Rev. E. L. Rexford, Pastor of the First Universalist Church, Boston Highlands. Remarks were also made by Messrs. J. M. Lauder and Angus Sinclair. At the October meeting the subject for discussion will be "Methods of Equalizing the Wear of Steel Tired Wheels and Machinery for Turning the Tires."

**American Roadmasters' Association.**—(*Concluded from page* 233). The excursion to Star Island on Wednesday afternoon was not an entire success. The *Idlewild*, which was to have taken the party, was laid up with a broken shaft, and the smaller boat which took her place showed such a decided tendency to careen on slight provocation that members of the party who could not swim and those who could but did not care to, left the boat at Belle Isle and returned to the city. The remainder of the party enjoyed a pleasant trip through the St. Clair flats, had a bountiful supper at Star Island and as soon as they reached the city on the return trip at the rather late hour of 10 P. M. came at once to the hall for the final session of the convention.

The election of officers was resumed and for the office of Secretary Jno. P. Ramsey, J. W. Wright, J. M. Mead and H. W. Reed were nominated. The first ballot resulted as follows: Ramsey, 26; Reed, 20; Wright, 7; Meade, 2. On the second ballot Secretary Ramsey was re-elected by a vote of 32 to 22, which was afterward made unanimous.

For a member of the Executive Committee, to serve 3 years, J. W. Craig, C. E. Jones, J. M. Kirwin, J. M. Mead and H. W. Reed were nominated. The ballot resulted as follows: Jones, 16; Craig, 14; Reed, 9; Kirwin, 9; Mead, 6. It was voted that the Secretary cast the ballot of the convention for Mr. C. E. Jones (C., B. & Q.).

As the place of holding the next annual convention, Minneapolis, St. Paul, San Antonio, St. Louis, Chicago and Richmond were placed in nomination. The first ballot resulted as follows: Minneapolis, 25; Chicago, 18, St. Louis, 6; St. Paul, 5; Richmond, 3. On motion, all except Minneapolis and Chicago were dropped from the list, and the second ballot resulted in the choice of Minneapolis by a vote of 36 to 22. After the customary resolutions of thanks, the final adjournment was taken. On Thursday, by the courtesy of the Michigan Central R. R. Co., the association enjoyed a trip to Niagara Falls.

# ENGINEERING NEWS

AND

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## COMING TECHNICAL MEETINGS.

**Engineers' Club of Philadelphia.**—Next meeting, Sept. 20. Secy., Howard Murphy, 1122 Girard St.

**South and Southwestern Railway Club.**—Next meeting at St. Louis, Sept. 25. Secy., W. H. Marshall, Rookery, Chicago.

**Engineers' Club of St. Louis.**—Next meeting, Oct. 1. Secy., W. H. Bryan, 30 South 7th St.

**American Society of Civil Engineers.**—Next meeting Oct. 1. Secy., John Bogart, 127 E. 23d St., New York.

**Association of Civil Engineers of Dallas.**—Next meeting, Oct. 3. Secy. E. K. Smoot, Elm and Austin Sts.

**Civil Engineers' Society of St. Paul.**—Next meeting, Oct. 6. Secy., G. L. Wilson.

**Western Society of Engineers.**—Next meeting, Oct. 7. Secy., J. W. Weston, 280 La Salle St., Chicago.

**Civil Engineers' Association of Kansas.**—Next meeting, Oct. 8. Secy., J. C. Herring, Wichita, Kan.

**Engineering Association of the Southwest.**—Next meeting, Oct. 9. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

**Civil Engineers' Club of Cleveland.**—Next meeting, Oct. 14. Secy., C. O. Palmer, 22 Cedar Ave.

**Boston Society of Civil Engineers.** Next meeting, Oct. 15. Secy , S. E. Tinkham.

**New York Railway Club.**—Next meeting, Oct. 16. Rooms, 113 Liberty St.

**Engineers' Club of Cincinnati.**—Next meeting, Oct. 16. Secy., J. F. Wilson.

**Western Railway Club.**—Next meeting, Oct. 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery, Bldg.

**Engineers' Society of Western Pennsylvania.**—Next meeting, Oct. 21. Secy., S. M. Wickersham, Pittsburg, Pa.

**American Society of Railway Superintendents.**—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

THE "recent progress of the metric system," as summarized by Mr. B. A. GOULD in a recent issue of the *Journal of the Association of Engineering Societies*, shows lamentably little real progress in the last 20 years toward the adoption of the system in any of the English speaking countries; and without their co-operation and consent it can never become anything like a universal system, since nearly two-thirds of the commerce and manufacturing of the world is in their hands. The largest item in the "progress" recorded is the distribution of delicately tested national standards for the meter and kilogram to some 39 nations. But the extreme delicacy with which the weight of the standard kilograms was determined is indicated most strikingly by the following paragraph:

> In the early weighings a curious fact became palpable, which indeed, ought to have been anticipated; and which has led to the substitution of the word *mass* instead of weight, in all the subsequent publications of the committee. The force of terrestrial gravity was found to vary perceptibly at the different balances [because of their difference in elevation] indeed, *the weighings show an appreciable difference between the weights of the two kilogram standards when one rests upon the other, and when they are placed in the pan side by side.* This will readily be appreciated when it is remembered that for 1 centimeter of greater altitude the force of terrestrial gravity for a kilogram is diminished by 0.003 milligrams. And since 0.001 milligrams can be recognized in a series of weighings, and the center of gravity of the two prototypes is higher in one case than the other by half the height of one of them—which exceeds 3 centimeters—the phenomenon was soon explained. The force of gravity at the Bureau has recently been carefully determined by the French army engineers, and the employment of the word "mass" removes all difficulty.

That the difference in the earth's attraction resulting from the removal of a body less than 0.1 ft. (.0984 ft.), or 1¼ ins. from its position relative to the center of the earth should be recognizable in a balance is indeed an impressive evidence of the delicacy of modern instruments of precision! That distance is about one 212,000,000th part of the radius of the earth at Paris; but weighing a kilogram to within a thousandth part of a milligram is equivalent to weighing it within $1,000 \times 1,000 \times 1,000 =$ a 1,000,000,000th part, or within five times the accuracy necessary to distinguish the effect of lifting the body 1¼ ins. further from the center of the earth.

THE construction of the Diamond Shoals lighthouse off Cape Hatteras, recently let to Messrs. Anderson & Barr, and fully illustrated in these columns, may possibly lead to an important new departure in the way of defense of our harbors, should the work be as successful as it is all but sure to be. Mr. ANDERSON has had for some time the belief that the sinking of some large caissons on the sandy shoals which exist at the mouth of nearly all our harbors adjacent to the channels, would give the best and cheapest of all means for constructing forts to effectually defend the channels, and he has this week seen fit to make public his ideas through the daily press as respects the harbor of New York.

His proposition in brief is to sink caissons similar to that in his design for the new light-house (ENGINEERING NEWS, July 26, 1890), but much larger, so as to give a fort 300 ft. in diameter, built of solid concrete, with walls 50 ft. thick, with or without (but preferably with), a bomb-proof dome of steel armor over part or all of the interior. Placing these forts about two miles apart, only three of them are required between the Long Island shore at Coney Island and Sandy Hook, and with the addition of a like fort on the Hook, they would completely protect the harbor, it is claimed, being practically indestructible by any kind of cannon or torpedo, and furnishing a secure base for dirigible and fixed torpedoes, torpedo boats and dynamite guns, as well as for ordinary heavy artillery. It would certainly seem as if a small garrison in each fort, handling a few only of these modern implements of war, ought to make the harbor absolutely impregnable; and if so, there is not a harbor on the Atlantic or Gulf coast, and hardly on the Pacific, for which the plan is not applicable; its special advantage being that it enables the forts to be placed very close to the channel on the one hand, and at a sufficient distance from the city to be protected on the other, regardless of the form of the natural shore line; and all at comparatively moderate cost; at less cost, in fact, than for the old style of fortifications, which required a large number of small guns rather than a few of great power.

BY the end of another season work on the new Hatteras light foundations should be so far advanced as to make it tolerably clear whether or not much larger caissons for small impregnable forts could be sunk, and it is so nearly certain now that this can be done without any special difficulty that Congress at its next session would do well to authorize the immediate construction of one such fort as an experiment. Even if the first investment of a million or so should be wholly lost, it would be a small matter compared with the importance of at once protecting our only vulnerable point for foreign attack—our rich coast cities. In that respect we are very vulnerable; in no other way can any foreign power or combination of powers effectively attack us. By simply closing the one weak gap, therefore, we shall attain a unique position among the nations which will be cheap indeed at the price; especially as this price need be paid but once. The caisson-forts suggested, so far as a merely civil engineer can judge, would be, or could be made to be so strong that no future progress in guns or explosives could well make them useless, while their means of offense, however improved in the future, would continue to be vastly more effective than they otherwise could be because of their location so near to the channels to be defended. Peaceful as this country is and is disposed to be, it is liable at any moment to be in urgent need of coast defenses, which the people do not sufficiently realize can no longer be improvised in time to do any good after the need for them has come. Good war ships, of course, we must have, and we are getting them, but to be fully protected in this way we must keep on building them indefinitely and much more rapidly than now. Forts of the type suggested, once built, are built forever, nor should they cost nearly as much each as first-class war ships.

## City Revenues from Companies Performing Public Functions.

The inadequate return for their privileges made by those private companies which use, and are so continually tearing up, the streets of all our large cities is briefly but forcibly and suggestively commented upon by Mr. LOUIS WAGNER, Director of Public Works, Philadelphia. Referring to the disturbance of the streets by electric lighting companies, Mr. WAGNER says, in part:

> The number of permits authorized show the continued disturbance of our highways. Underground companies are being organized, and are asking Councils for privileges which will, if granted, continue indefinitely the tearing up of street pavements and the interference with the transaction of business by the general public. In addition to the money expended by the city to make good the damage done, these private companies come into direct competition with the interests of the city in the consumption of gas [Philadelphia makes its own gas] and some sufficient return should be exacted for the valuable privileges granted them.
>
> Why should not the companies which have received, or shall hereafter receive the right to occupy the city's streets with their wires, whether overhead or underground, be required to light these streets free of cost? At present the city receives no adequate return for the opportunities afforded these corporations to make profits at the expense and to the injury of the city's property.

At first thought the above may seem to be but another instance of the unreasonableness sometimes shown by municipal officers in their treatment of private corporations performing public functions within city limits, but further consideration and some figures bearing upon the subject, will, we think, show that Mr. WAGNER is sound in his views.

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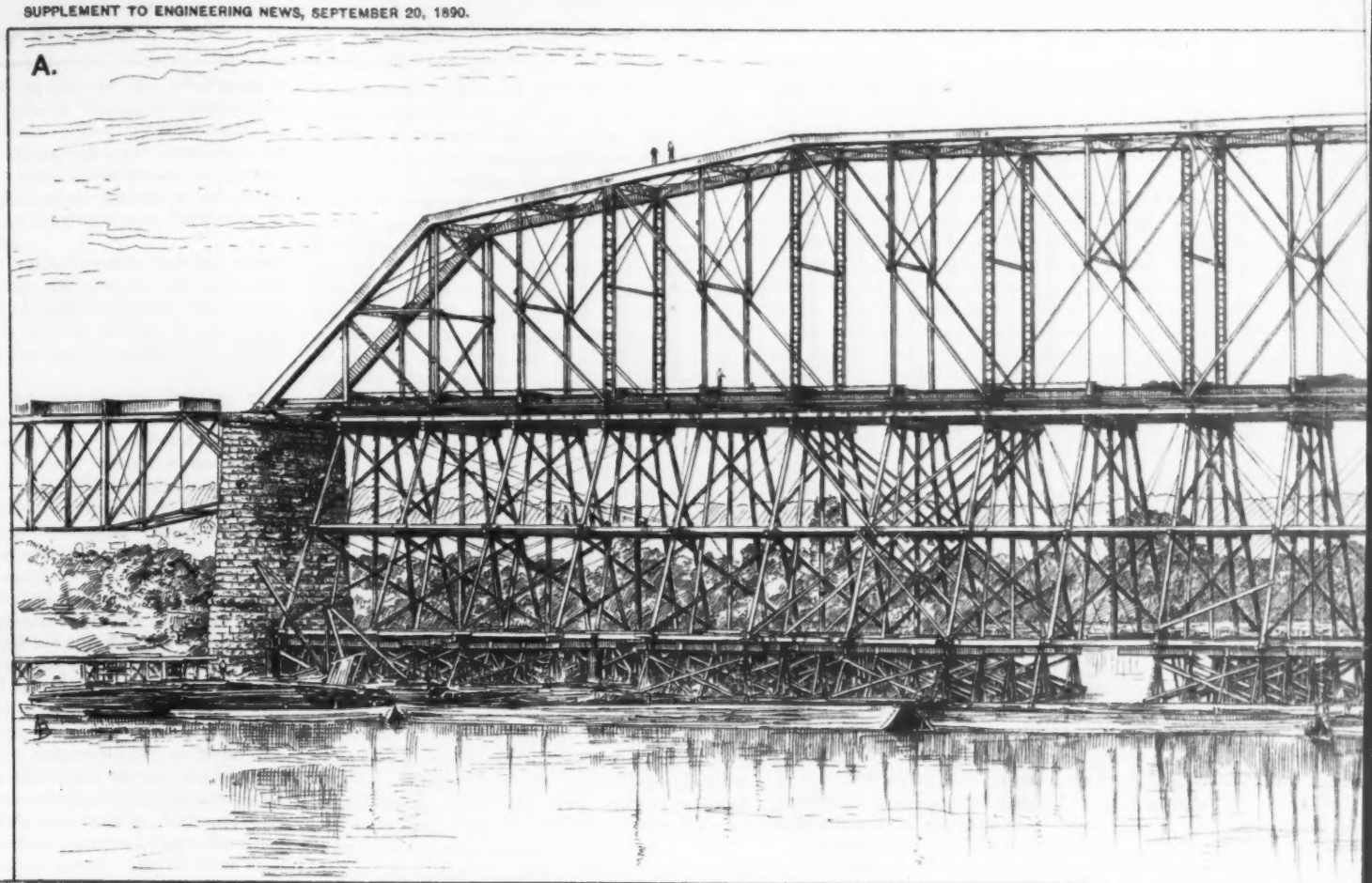

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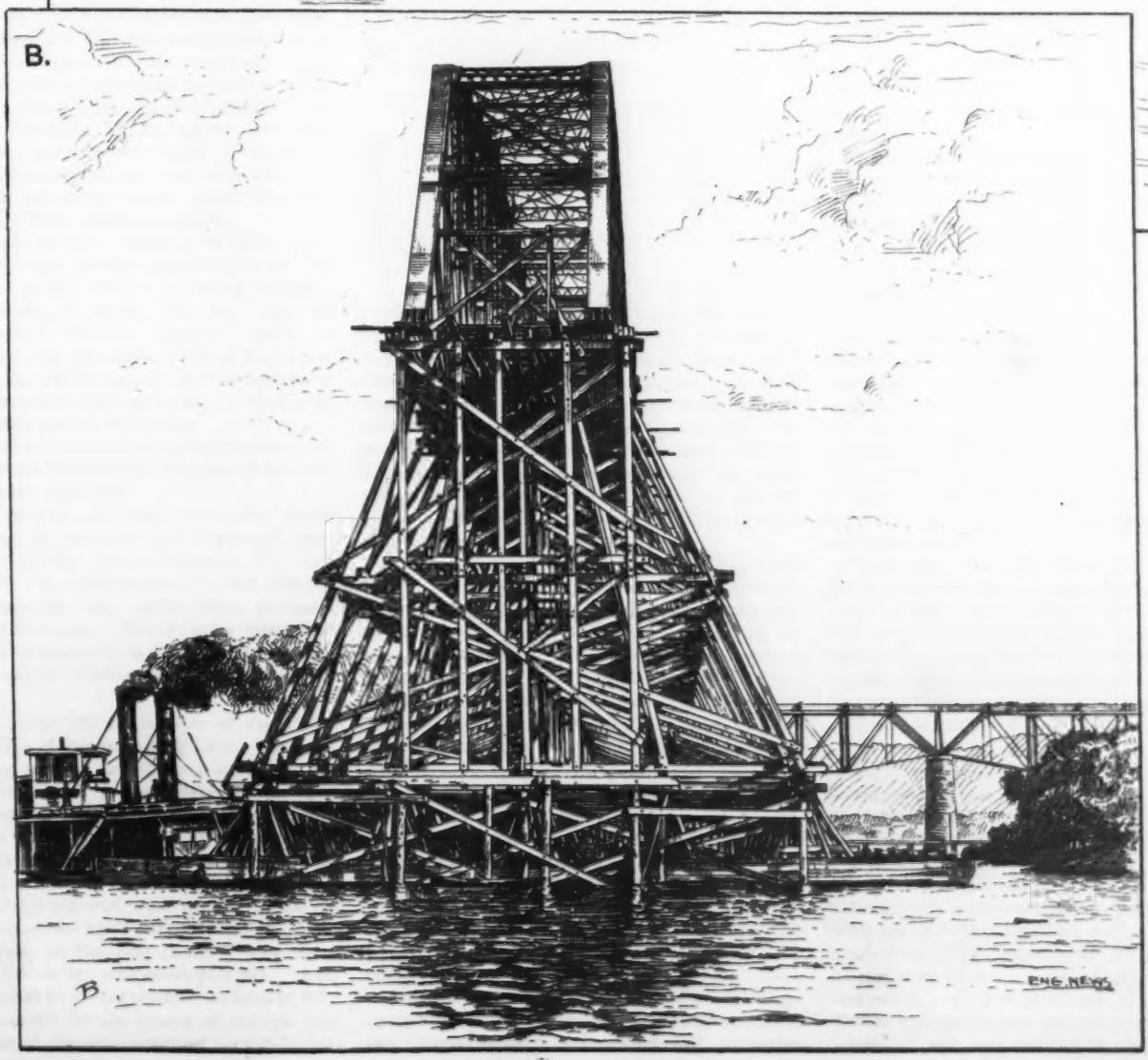


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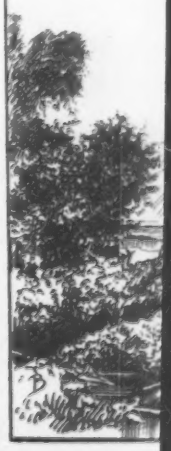
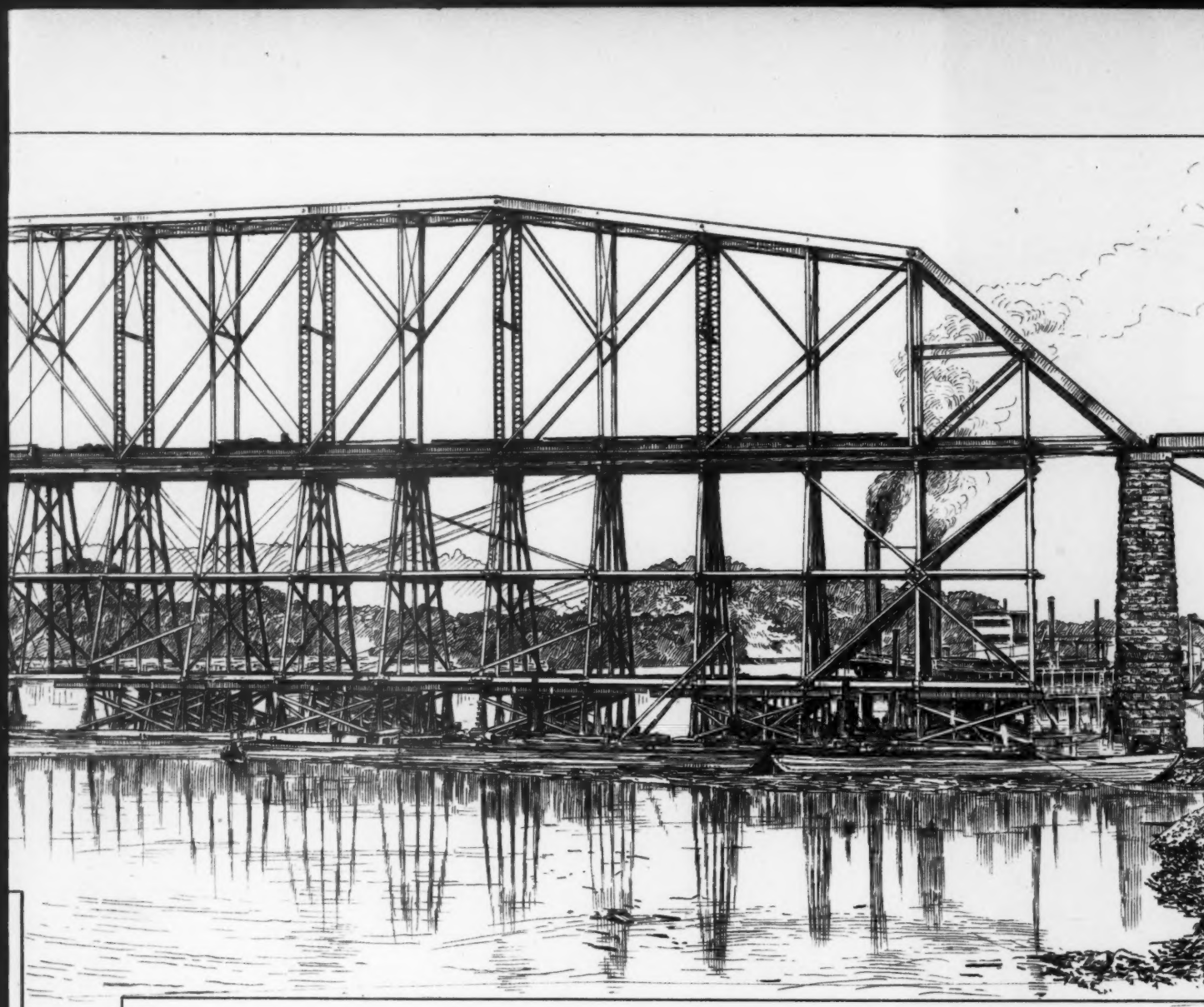


# THE OHIO CONNECTING RAILWAY

C. L. STROBEL, CHIEF ENGINEER, KEYSTONE BRIDGE CO. KEYSTONE BRIDGE CO., C

A. THE 523 FT. SPAN IN POSITION ON PIERS. B. THE SPAN WITH BARGES IN



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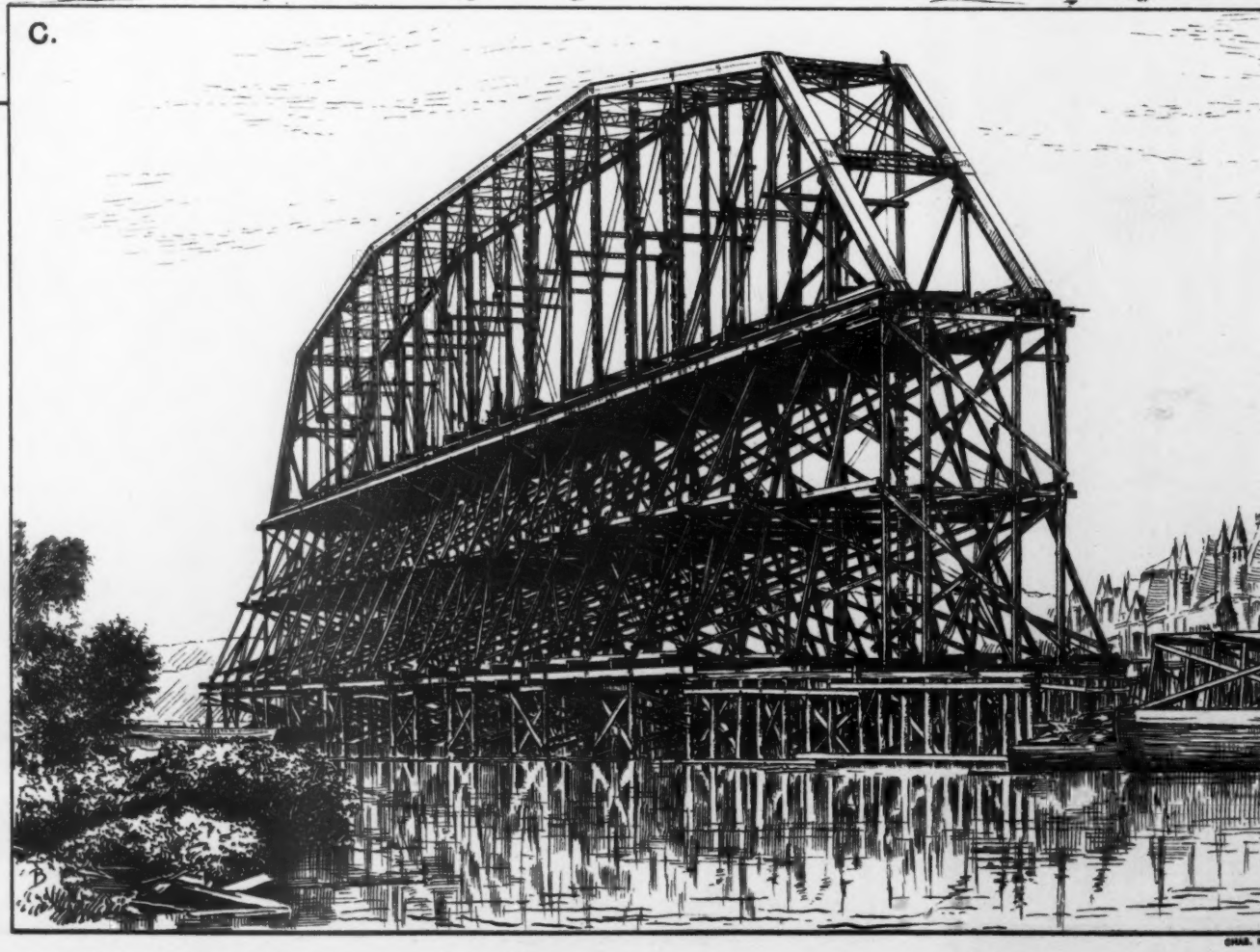


ECTING RAILWAY BRIDGE, AT PITTSBURG, PA.

KEYSTONE BRIDGE CO., CONTRACTORS. MAX J. BECKER, CHIEF ENGINEER, OHIO CONNECTING RY.

THE SPAN WITH BARGES IN POSITION BENEATH.

C. THE SPAN AS BUILT ON FALSEWORKS AND PILES.

A. THE 523 FT. SPAN IN POSITION ON PIERS.

B. THE SPAN WITH BARGES IN

CHAS. HART & SONS, LITH., 80 VESEY ST., N.Y.

U. S. THE SPAN AS BUILT ON ASSEMBLING ARD FILES.

THE SPAN WITH BARGES IN POSITION BENEATH.

It is well known, at least by the inhabitants of New York, that miles of well-paved streets have had their pavements ruined by being torn up almost as soon as the paving is put down, by what have been well termed underground companies. Aside from the permanent damage to the streets the temporary inconvenience and hindrance to travel is very great.

In the case of overhead electric lighting, which is as yet the rule in this country, the poles and wires are certainly a disfigurement to the streets, and the latter are often a menace to life, while both partake more or less of the nature of obstructions.

Nearly all the gas and electric lighting companies receive fixed yearly rentals for street lights from the city in which they are located, but it is a rare case indeed, if one of these companies pays the city a cent for the privileges granted it and for the damage and inconvenience which it causes. True, most of these companies pay taxes, but so do other private corporations.

In some of the smaller cities it may be that the gas and electric lighting companies are not earning more than fair returns on the capital invested, and therefore could not afford to pay for the privileges granted them, but when well managed many companies could do so, especially in the larger cities. It should always be borne in mind, that many of these companies have an enormous capitalization, and that sometimes two or more companies have been allowed to lay gas mains in the same street, the new companies promising to reduce the rates; and that consolidation, increased capitalization and higher prices have been the result. This has happened on a large scale in New York, Chicago and Baltimore, not to mention other cities.

It is notorious, too, that heavy capitalization is one of the principal causes for seemingly small profits, and is often a mere cloak to cover a multitude of sins. If the actual capital involved was known, and especially if no capital had been wasted in the duplication of plants, it would be evident that these companies could well afford to pay the public for the privileges which it grants to them, and which it alone can grant.

The ability of the gas companies, at least, to pay something for their privileges seems apparent, and if they had to pay, while it would certainly lead to efforts to make the city pay its bills indirectly through higher rates to consumers, yet, on the other hand, it might possibly lead to the better conduct of the business of such companies and to sounder views of their relations and obligations to the public.

As a concrete illustration let us take the financial operations of the Philadelphia Bureaus of Gas and Lighting for the year 1889.

Philadelphia is the only large city in the United States owning its gas plant, and Richmond, Danville, Charlottesville and Alexandria, Va., and Wheeling, W. Va., Bellefontaine, O., and Henderson, Ky., are the only other cities similarly situated in this respect. Fifty or more cities and villages own their electric lighting plants, but we will in this article confine ourselves to gas works only.

During the year 1889 the receipts of the Philadelphia Bureau of Gas were $3,658,225. The current expenses were $2,558,873, thus leaving a net revenue of $1,099,352, of which $292,146 was used for permanent improvements and the remainder turned into the city treasury. These figures do not take into account the interest on the gas debt, which is not stated in the report, but neither do they include any allowance for the 481,020,000 cu. ft. of gas used to light the city buildings and streets, which, at the rate charged consumers, $1.50 per 1,000 cu. ft., was worth $721,532. Adding this amount to the net revenue we have $1,821,000, which would be the excess of receipts over expenditures if the gas consumed for public purposes was paid for at the above-named rate.

Such large profits, and in a city where the price of gas is but $1.50 per 1,000 cu. ft., show that gas works well managed can be made to yield such a revenue as to enable gas companies to make some return for the privileges granted them.

For we have seen that, while furnishing free of charge gas for lighting the streets and public buildings of the city of Philadelphia, gas works yielded a net revenue of $1,099,352 in 1889. The percentage of revenue on the capital invested cannot be stated here, as the cost of the plant is not mentioned in the report of the Director of Public Works, but this sum would pay an 8 per cent. dividend on $13,741,900 or a 5 per cent. dividend on $21,987,040, which shows that a large profit must be made on the capital invested, or at least on the necessary cost of the plant. The estimated cost of the plant may be placed at $16,000,000, which would be about $5 per cu. ft., manufactured in 1888, or manufactured and bought in 1889, a liberal allowance, according to good authority. In 1887 one year's interest on the "gas loans" and a payment to the sinking fund of a sum not designated amounted to only $290,500, and the debt on the plant has not increased since then, as the cost of all extensions has been met from the revenues of the works.

If such results can be obtained by the public gas works of Philadelphia, selling gas at $1.50 per 1,000 cu. ft. and receiving nothing for lighting streets and public buildings, is it not true that the private companies in nearly all our cities, many of which charge much higher rates, can at least well afford to light free of cost the streets through which their mains extend?

Let us see what the actual cost of Philadelphia gas was in 1889 and what reductions have been made in the last six years. From the report already referred to we find the cost to be as follows:

| Year. | Cubic feet manufactured. | Cost in dollars per 1,000 cu. ft. In holders. | Delivered to consumers. | Extensions. |
|---|---|---|---|---|
| 1884..... | 2,557,678,000 | .73 — | 1.09 + | .22 + |
| 1885..... | 2,757,844,000 | .73 — | 1.03 + | .16 + |
| 1886..... | 2,946,407,000 | .70 | 1.06 + | .11 + |
| 1887 (3 mos.)... | 941,415,000 | .97 — | 1.30 — | .10 — |
| 1887 (9 mos.)... | 2,213,427,000 | .67 — | .97 + | .07 — |
| 1888..... | 3,200,874,000 | .66 | .91 + | .11 + |
| 1889 Manufactured by city | 2,231,509,000 | .60 + | | |
| 1889 Water gas purchased.. | 919,647,000 | .37 + | | |
| | 3,151,156 000 | .52 + | .74 + | .15 + |

Since the first quarter of 1887 there has been a steady reduction in cost from $1.30 to 74 cents, or 43 per cent. in 2¼ years, the result of new and efficient management. The reduction in 1889 is largely owing to the use of a considerable amount of water gas, which is furnished by a private company and mixed with coal gas with good results. The city has the option of purchasing the water gas plant in the future, after which the cost of manufacturing can be reduced by the amount of the companies' profit.

It should be stated that the cost of gas delivered to consumers includes *all* the attendant expenses, and that the cost of extensions represents the payments for new works, mains and services less the receipts on these accounts; also that the decrease in the amount of gas manufactured in 1889, as compared with 1888, is due to the decrease in leakage and waste, and also that the total receipts mentioned above includes amounts received for residuals.

The time is surely coming when our cities and villages will realize that supplying gas, water, electricity and rapid transit facilities are functions to be fulfilled, not necessarily by our municipalities as now constituted and managed, but always with the interests of the citizens foremost. No company can supply these necessities without first securing from the municipality permission to occupy and use some part of its streets. Such occupation and use is always a valuable privilege, and always causes more or less inconvenience to the citizens through obstructions and otherwise, and often so damages pavements as to cause the city increased expense for repairs and renewal. Yet, notwithstanding all this it is but seldom that one of these companies is even asked to give any direct return for these privileges, either in the way of money or reduced rates for service.

It is pleasant to see Director WAGNER, of Philadelphia, urging a reform along this line for his city, and also to see that Mayor FITLER concurs with him. Already the Edison Electric Light Co. supplies free of cost electric lights for the offices of the Philadelphia Bureau of Water, in return for the privilege of laying conduits on Filbert St., and the financial operations of the Bureau of Gas show that if the gas works of the city were owned and operated by a company it could well afford to light the streets free of charge for the privilege of laying and repairing mains and supplying private consumers.

Large European cities own and operate their gas works at a profit, and some of them charge far lower rates than Philadelphia. In fact, American gas rates as a rule are among the highest in the world. Undoubtedly we shall see, sooner or later, a great change of public opinion regarding the control of natural monopolies, and the change of opinion will be followed by a speedy change in practice. Already shorter franchises are being granted to water, light and street railway companies, and regulative provisions are being inserted in these franchises which will be of great benefit to the general public; but these restrictions should be still more stringent, and reserve a much larger proportion of the profits than they do now for the public instead of private use.

It is safe to say that there are few cities in the United States with both an adequate and a thoroughly potable water supply; that there is not even one city properly paved and sewered; that nearly all need improvements in their lighting; and that most of our cities of any considerable size need increased rapid transit facilities and more and better parks.

And it is quite as true that in every city the tax rates are by most of the taxpayers considered excessive and by a large majority regarded as burdensome; yet there is not a city in the land which might not largely increase its revenues, further extend and improve its public works and at the same time decrease rather than increase its tax rates if only it would insist upon receiving from the private companies within its limits a fair, but not burdensome, return for the privileges they have been granted in connection with such natural monopolies as the supply of water, light, transit, heat, power, telephonic and telegraphic facilities; in fact, the supply of all wants, which are of such a nature that they involve certain special privileges which must be more or less monopolies, and which hence necessitate the grant of special powers from the city authorities.

Many cities, not to say all cities, have already given away valuable privileges for long terms, but it still remains open to them to watch more carefully their interests in the future, and either to refuse further franchises not containing provisions for city revenues, or to construct, or purchase, and maintain their own public works for the exclusive and general benefit of their citizens.

We recognize, of course, the many advantages in the private control of these works, and beyond doubt many of our cities would still be without as good services as they now have, had it not been for private companies. It is also certain that private companies performing these public functions are often shamefully ill-treated: and that the management of such works and plants by the public presents grave difficulties under our present political conditions. The Philadelphia gas works, for example, were for years a sink of iniquity, controlled and run by a gang of plunderers only second to the TWEED ring in iniquity and shamelessness. Those interested will find the whole disgraceful story pithily told in Mr. JAMES BRYCE'S masterly work

on "The American Commonwealth;" we will not rehearse it. But that Augean stable was cleaned out at last by a flood of public indignation, as such stables generally are in this country, and to-day the management is quite as good and as clean as that of most private companies; while with all the robberies of the "gas ring" there can be no doubt that on the whole the city has already gained far more than it has lost from public ownership of the works; while from now on its profits will go on increasing.

This article is not written, however, to urge that all such semi-monopolies should be owned and controlled by the people; but only to urge that private companies should not be allowed to obtain valuable franchises without paying the public their fair value, and still less to abuse such privileges when they have obtained them by throwing still further burdens and losses on the public, which they make little pretence of even seeking to avoid.

## Notes in Detroit.

[EDITORIAL CORRESPONDENCE.]

To the stranger entering Detroit, especially if his train arrives at night, the thing which is first noticeable is the system of public lighting in use, and if he be a lover of the picturesque he can scarcely fail to be pleased with it. The city consists of a business district of small area, and a very large district surrounding it, on which the buildings are in many sections no closer together than in the average country village. Scattered all over this thinly populated district are slender iron towers averaging 150 ft. in height, each of which carries at the top four electric arc lamps. The towers are of triangular cross section and are built with tubular compression members and light tie rods. At the base the tower is supported on a single column hardly larger than an ordinary lamp post; and its lateral stability is due solely to the wire rope guys which are attached near the top. At a little distance the guys are invisible of course, and the tower looks as if a very mild cyclone would bring it down.

While the appearance of the lights on a dark night is certainly pleasing as you look across the level plain on which Detroit is built, and see the bright arc lights scattered here and there, as far as the eye can reach, the general testimony seems to be that for lighting the streets they are a picturesque failure. The light is diffused over too wide an area, and, moreover, the towers are placed so far apart that very considerable districts get only enough light to make the darkness visible. It would seem that this defect was rather aggravated by the location of the towers. Instead of scattering them at equal distances over the area to be lighted, they seem, as a rule, to be grouped in twos. For example, one tower and its neighbor will be set within a hundred yards of each other and there may be no others within a half mile. The total number of towers in the city is only 103.

STREET WORK.

Detroit has a very large amount of cedar block paving, a material which has received more condemnation perhaps than any other road covering known, unless it be pure unadulterated mud. And yet, with all its faults, wood paving has done good service in Detroit, and where a better paving cannot be afforded, it can well compete with such paving materials as brick and broken stone.

Many streets of heavy traffic in Detroit are paved with cedar blocks, and while undeniably there are hills and hollows to be found, they are no worse than, and perhaps not quite as bad as, those in the Belgian block paving on the principal streets of some of the largest cities in the country.

Well laid cedar block paving in Detroit lasts 8 to 10 years, and on some streets even 15 or 20 years. The original cost is from $1.25 to $2.00 per sq. yd., and it can be renewed when worn out at a cost of 50 to 60 cts. per sq. yd. It is generally laid on sand, with sand brushed between the blocks. A pavement that is much more even, but which costs considerably more, is made by laying the cedar blocks on concrete, with a cushion of sand between, and filling with coal tar between the blocks.

Asphalt is finding much favor to replace cedar blocks on streets of heavy traffic. About 3 miles of streets are now paved with asphalt, and appropriations have been made for about 5 miles more, on which work is now in progress. It is not to be wondered at that in deciding upon a pavement to take the place of wood blocks, asphalt should have been chosen instead of stone. Citizens accustomed to the use of wood paving would be apt to object most decidedly if the noisy granite block paving took its place in front of their doors.

Besides its freedom from noise, the ease with which it can be repaired is an important point in favor of wooden paving. With all the pipes already beneath the pavements, and the certainty that it will be necessary more or less frequently to break the pavement to repair and add to them, this matter of ease of repairs is a most important feature.

Among experiments in the paving line are some streets paved with a combination of cedar block and cobblestone. The single horse car track in the center is paved with cobblestone; a width of about 8 ft. on each side is paved with cedar blocks, and the rest of the way to the curb is paved with cobblestone. The advantages aimed at are obvious enough. The disadvantages which have developed are that the wood paving shows a tendency to wear in ruts, as the vehicles run so nearly in one track.

Of course, one reason for the extensive use of cedar block paving in Detroit is the proximity of the city to the cedar forests in Northern Michigan. As an experiment in still another direction, a street is now being paved with brick. Macadamized roads seem to be unknown in the city or its suburbs, gravel or stone being scarce in the immediate vicinity.

In its street railway equipment, Detroit is rather behind the times. There are two electric railways in the suburbs; but over all the city railway tracks the overworked car horse still ambles patiently along. Electricity will probably be put on the principal lines soon, however.

THE MICHIGAN CAR COMPANY'S SHOPS.

Four of the largest manufacturing enterprises in Detroit are closely related in ownership and management, each of them having at the head of its list of officers Mr. JAS. MCMILLAN, whose high standing in the railway, financial and political world is well known. These are the Detroit Car Wheel Co., the Michigan Car Co., the Detroit Pipe and Foundry Co., and the Baugh Steam Forge Co. The works of the three first-named companies are located adjacent to each other, and together employ about 3,000 men.

Of this number about 2,000 are employed in the car works. In the forge shops a novelty has recently been introduced in the shape of a pneumatic riveter for work on truck frames. The machine is exactly like the riveters used on bridge work and has proved a valuable tool in saving labor and forwarding work.

The wood-working shop is equipped with modern machinery throughout. It would make a carpenter of the last generation stare to see how almost every kind of mortising, gaining, tenoning, boring and similar operations, which were once done slowly and laboriously by hand tools, are now done by swift-running chisels and bits with a rapidity which seems magical.

When these shops were established the timber supply lay right at their doors in the splendid pine forests of Michigan. Now this supply is well nigh exhausted, and the superior quality of the Southern pine has led to that being largely specified for car sills, etc. A considerable proportion of the timber used, therefore, comes from the South.

As far as possible throughout the works the rule is followed that the material at every stage of manufacture shall move toward its final destination. The finished material is brought into the erecting shop at just the place it is wanted. Five parallel tracks run through the erecting shop. At one end the trucks are set up. As soon as two are completed they are rolled forward into the next bay, where the sills and framework are put on. The draw gear, brake gear, etc., which require work underneath the car and upon the sills, are next put on, before the floor is spiked on, since after that is done access to the sills and framework is more difficult.

When the floor is on the car is drawn forward to the next shop where the siding and roof are added, and the grab irons, ladders, door furnishings and other iron work is put on; then another move ahead of a rod or two is made and the car halts in the paint shop.

This system seems to work with the least possible loss of time in movement of men, tools and materials. Each part is delivered at the place where it is to be used, and the gang engaged in one sort of work does not interfere at all with those working in another department. The principle is one aimed at in all modern shops, but at few is it carried out so perfectly as here.

It is encouraging to see the large proportion of cars which are turned out now with air brakes and M. C. B. automatic couplers. Improved draft rigging is less common, but many continuous drawbars are being applied. Steel as a material for car construction seems to make its way rather slowly. Many steel axles are being used, and pressed steel in place of cast iron has evidently come to stay. The pressed steel box lid, especially, promises to become the standard cover before many years in fact as well as in name.

The shops are now working on a large order from the Union Pacific. Some stock cars which are now being built for that road are known as the "feeding and feed-watering" cars. A hayrack made of round iron rods is hinged against the inside of the car, and can be filled by letting down a cover moved by a crank on the outside. A perforated pipe runs along this hayrack, and, by connection with a hose, the hay can be thoroughly sprinkled. Thus the grass-fed cattle will eat the moist hay and keep in good condition, when they would refuse dry hay and arrive in market in bad order.

For putting on large lettering on cars built at these shops a novel stencil is employed, in which the open spaces are covered with brass wire netting of about ⅛ in. mesh. A short stiff brush is used, with which the workman beats the stencil instead of brushing it, and so gets a good body of thick white lead upon the car. This lettering is said to keep bright much longer than that put on with the ordinary stencil, which cannot be thoroughly brushed in without danger of the paint creeping under the plate.

In the car wheel foundry adjacent to the car shops a very ingenious system is employed for handling the molten metal from the cupolas to the flasks, and carrying the wheels to and from the soaking pits. The work is done by machinery entirely, a system of overhead trolleys moved by a wire rope connection carrying the ladles, flasks, and wheels. The system is the invention of Mr. J. H. WHITING, the superintendent of the foundry department.

This foundry has a capacity of 400 car wheels per day. About 130 tons of metal can be handled in 6 hours by the system of trolleys above referred to. A large proportion of the cast iron segments for lining the St. Clair tunnel was made in this foundry, and the plant proved very convenient for their rapid handling.

THE DETROIT BRIDGE AND IRON WORKS.

The largest contract on which these shops are now at work is a viaduct for the Union Pacific Ry. at Omaha, Neb. Several of the large plate girders for this structure, each 65 ft. in length and 6 ft. deep, were in the shops. A few years ago girders of this size were an uncommon thing; now the tendency is to build more and more of this heavy work in place of small trusses. The viaduct is to be built in connection with the new Union passenger station at Omaha, illustrated in ENGINEERING NEWS, Aug. 17, 1889.

A rather uncommon machine at work in one of the shops was a gang reamer. It had 10 boring heads and appeared to do very rapid and good work. When one considers what a large proportion of the work of bridge and girder construction consists in preparing the parts for riveting, it seems strange that gang punches, reamers and drills are so little used. Probably one reason for this is the difficulty in making a machine to suit the widely varying classes of work which a bridge shop has to undertake.

## CORRESPONDENCE.

### Temperature Regulator Consolidated Car-Heating Co.

ALBANY, N. Y., Sept. 13, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR.—I desire to express my appreciation of the extended and carefully written notice of our new appliances which appeared in your issue of Sept. 6. As to the temperature regulator, it is actuated by a fluid in the diaphragm. The fluid is exceedingly sensitive to a change of tempera-

ture above 68° Fahr. Below this point it remains passive. At 68°, or whatever it may be adjusted for, it vaporizes and exerts a pressure under the diaphragm; and, owing to the area of the diaphragm, the pressure exerted is sufficient to close the steam inlet valve of any of our systems.

The diaphragm containing this fluid is placed in proper position in the car, to be actuated by the average temperature. A cam, rotated by an index lever, pivoted on the center of the diaphragm, compresses the diaphragm to such extent as may be required to prevent the operation of the steam valve until a temperature of 73° is reached. Consequently, it will be seen that by adjusting this lever in accordance with the dial any degree of temperature may be maintained that may be desired between 68° and 74°. Our patent upon the essential parts of the same is No. 436,045 and is dated Sept. 9, 1890. Applications covering the use of the liquid are well under way and we expect the patents will be granted within a few days.

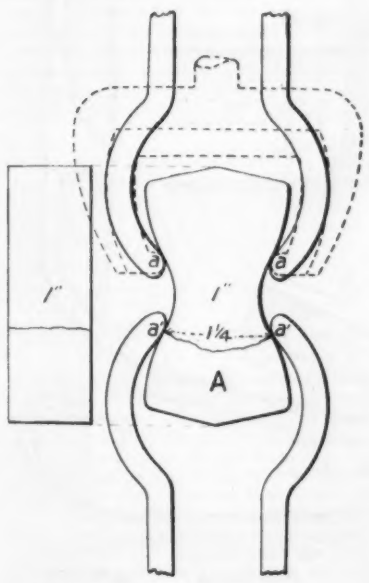
WM. G. RICE,
Vice-Prest. and Treas. Consolidated Car-Heating Co.

## Cement Tests.

BATAVIA, N. Y., Sept. 12, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

Sir. Enclosed I send you a diagram showing how some cement briquettes break as indicated by the arched line between the points of the clip $a'$ $a'$. In some instances the lower part marked $A$ falls out, leaving the remainder wedged in the clips, top and bottom. My theory is the briquette is broken by compression, the irregular arched line seems to indicate the line of force exerted by the




Clips for Testing Cements.

points of the clip as the strain comes on, thereby pinching the piece off, instead of pulling it off; My idea of a perfect clip is that it should be constructed to grip as you would with your thumb and finger, or in other words, the same shape as the mould in which the briquette is made.

I should be glad if you would set me right on this matter. JOHN K. LLOYD.

[The clip shown is not of the form recommended by the committee on cement tests of the American Society of Civil Engineers, for which see our issue of Dec. 19, 1885, or Trans. Am. Soc. C. E. vol. xiv. p. 484. We indicate by dotted lines on the cut the form recommended, which was changed from the form at first recommended by them (in January, 1884), only by adding the strengthening ribs and slightly flattening the bearing surfaces. The committee found this form of clip to be the best of any, and substantially satisfactory; and therefore, we apprehend that our correspondent will get satisfactory results if he changes his clips to the standard form.—ED. ENG. NEWS.]

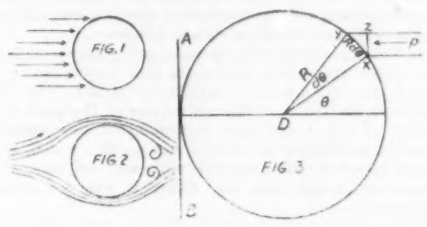
## Wind Pressure on Cylindrical Surfaces.

CHIEF ENGINEER'S OFFICE, CANADIAN PACIFIC RY.,
MONTREAL, P. Q., Sept. 12, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR. In your issue of Aug. 2, while discussing the pressure of wind against the proposed Diamond Shoals Lighthouse, Mr. THEODORE COOPER repeats Prof. RANKINE'S statement that a certain wind pressure per square foot on a cylindrical surface only gives an effective pressure equal to one-half that on a plane surface of the same area as the projection of the cylinder. The older editions of RANKINE give no particulars of how he arrived at this conclusion, and I have not seen any new editions.

The opinions of both the gentlemen above mentioned are entitled to the greatest respect; however, I think that this effective pressure of *one-half* refers only to the case of a steady uniform current, either of wind or water, where the element has time to arrange itself in a stream,




as per Fig. 2, and does not refer to the case as illustrated in Fig. 1 of Mr. COOPER'S article on page 101 of ENGINEERING NEWS, which figure is here given.

In case of a sudden gust of wind, or of a wave, it would seem more probable that the pressure would be parallel, as shown in Fig. 1, and this seems to be Mr. COOPER'S assumption.

I have not seen a theoretical solution of this case in any text book, and therefore offer the following: Take any small section of the surface of the cylinder, one unit in height, subtended at the center by an angle $d\,\theta$ (Fig. 3) and at an angular distance $\theta°$ from that diameter of the cylinder which is parallel to the direction of the pressure. The length, $x$ $y$, of this section is $R\,d\,\theta$, $R$ being the radius. The cross section of the column of fluid pressing against this element is $x\,z = R\,d\,\theta \times \cos\theta$, the pressure $p$ on $x$ $y$, letting $P$ = the pressure per unit of surface, is therefore $p = P \times R\,d\,\theta \times \cos\theta$. The amount of this pressure resolved normally to the surface of the cylinder is $P \times R\,d\,\theta \times \cos^2\theta$, and the amount of this normal pressure, again resolved parallel to the direction of $P$, *i. e.*, perpendicular to $A\,B$ is $P \times R\,d\,\theta \times \cos^3\theta$. The integral of this, between the limits $\theta = o$ and $\theta = 90°$ is

$$P \times R \int_o^{90°} \cos^3\theta\, d\,\theta = P \times R \int_o^{90°} (1 - \sin^2\theta)\cos\theta\, .\, d\,\theta =$$

$$P \times R \times \tfrac{2}{3},$$

which is the pressure against half the exposed side of the cylinder, the total pressure for a portion one unit in height being $\frac{2}{3} \times P \times D$, or two-thirds of the effective pressure against a plane surface of same area as the projection of the cylinder.

A small addition to this two-thirds might also be made for the resistance of the air or water to lateral displacement, and also for the effect of friction due to the tangential component of the pressure.

It would seem, therefore, that your estimate in your issue of Sept. 6, page 213, of six-tenths as the proportion between the pressure against a cylinder and that on a plane surface of same area as its projection might be increased to seven-tenths for sudden gusts of wind or for waves. The increase to seven-tenths would, in any case, be on the side of safety. H. IRWIN.

[The pressure of fluids against plane or curved surfaces is a subject which cannot be treated mathematically with any degree of success, although such an investigation as that given by Mr. IRWIN is of value in checking the experimental results which should always have the most weight in preparing a formula for physical phenomena. The values of the coefficient by which the pressure of a fluid against a plane surface is to be multiplied in order to obtain the pressure against a curved surface of equal projected area have been found experimentally, and are by no means exact. The reason of this is that a body moving in a fluid or resisting the motion of a fluid is surrounded by a coating, or atmosphere, of the surrounding matter, compressed in front and rarefied behind, which so modifies the actual shape of the surface of impact that the shape of the section along which the pressure should be integrated is unknown. The photographs of moving shell from rifled cannon which were quite widely published some time ago in several magazines and illustrated weeklies, showed this compression and rarefication with great clearness. An extended elementary discussion of the whole subject will be found in Chap. IX. of WEISBACH'S "Mechanics," where is also a long list of other works on the subject.—ED. ENG. NEWS.]

## The Kinzua Viaduct—Correction.

PHŒNIXVILLE, Pa., Sept. 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR.—The report having been widely circulated by the press of the United States that the great Kinzua Viaduct, on the line of the New York, Lake Erie & Western Railroad was to be removed on account of its not being strong enough and that a new line was to be constructed around it, I addressed a letter to Mr. CHAS. W. BUCHHOLZ, Engineer of Bridges and Buildings for the N. Y., L. E. & W. R. R. Co., asking whether this rumor was correct and if so why the viaduct was to be removed, and whether it had shown any signs of weakness in any part, such as loose rivets or any excessive deflection or lateral motion.

To this inquiry Mr. BUCHHOLZ replied as follows:

DEAR SIR: In answer to your favor of the 4th inst., I beg to say that the announcement that the Kinzua Viaduct is to be abandoned is a mere newspaper rumor.

I heard nothing of it until last week while I was in Chicago.

The structure has shown no signs of weakness of any kind and maintains its full efficiency for the loads it was designed to carry.

This viaduct is one of the most important railway structures in the world and is of recent construction, having been constructed in 1882. It is 2,052 ft. long, 301 ft. at its greatest height and divided into groups of spans of 40 and 60 ft. alternately. It is designed for carrying trains of coupled consolidation engines, each engine weighing 161,340 lbs. on a wheel base of 45 ft. 3 ins. and 88,000 lbs. on a wheel base of 14 ft. 9 ins. It is proportioned to resist a wind pressure of 50 lbs. per sq. ft. on the unloaded structure and 30 lbs. per sq. ft. on the loaded structure. Under the above load no part of the structure is strained more than one-fifth of its ultimate strength. The viaduct is as safe and as strong as 90 per cent. of all the railroad bridges which are now in daily use.

ADOLPHUS BONZANO,
Vice President and Chief Engineer Phœnix Bridge Co.

## A Case for Rerailing Guards—Correction.

WASHINGTON, D. C., Sept. 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR. I note in your issue of 13 inst. that you give an account of the failure on Sept. 6, 1890, of a bridge on the Richmond & Danville R. R., which is so entirely contrary to the facts, I write to correct the mistake.

This bridge was over the Yadkin River, and was a combination deck bridge, four spans of 156 ft. each; built about four years since and of good proportions for the heavy service being put over it. The occasion of its falling was as follows: The engine, of the consolidation type, weighing 120,000 lbs., left the track a quarter of a mile south of the bridge, and ran onto the bridge with drivers off the track; it passed over the first span and nearly over the second, when it fell from the bridge, carrying its train with it, and in falling struck the lower chord, tearing two spans down. Under the circumstances the bridge did everything that could be expected of it.

CHANNING M. BOLTON,
Chief Engineer, R. & D. R. R.

[The press dispatches, on which our note of the occurrence was based, made no mention of there being any derailment, but did speak of the bridge as a "handsome new one," and state that it was "supposed" some part of the truck had broken on the bridge, and thrown the engine off, which last we naturally spoke of as doubtful. From Mr. BOLTON'S account it would appear that the bridge certainly did "everything that could be expected of it under the circumstances," but the new statement of facts raises the new query, which we trust the officers of this and all other roads will duly weigh: Can as much be said for those who leave such bridges without the protection of rerailing guards?—ED. ENG. NEWS.]

## Alleged Iowa Central Bridge Failure—Correction.

MARSHALLTOWN, Iowa, Sept. 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of 6th inst. I find a statement saying: "A bridge fell under an Iowa Central freight train on Aug. 27. It was an old wooden bridge over a small stream near Peoria, Ill." I beg leave to say to you that you have been misinformed as to the facts, which were as follows: The bridge, a pony Howe truss 64 ft. long, over Kickapoo Creek, was built in 1885, was in first-class condition, and was partially knocked down on Aug. 27 by derailed cars; one freight car and caboose having ridden over the top chords the entire length of the span; another tearing away all the inside main braces, and part of the counter-braces, while still another struck the first panel set of rods, bending them almost double, and drawing the chords together and breaking them just under the second panel point; yet, notwithstanding all this, the engine and entire freight train following passed

over the bridge (it being a rear end collision), and still the bridge stood up.

O. J. TRAVIS,
Supt. Bridges and Bldgs., Iowa Central Ry.

[We must repeat that we simply abstract the press despatches in regard to many occurrences of this kind, which are not specially reported to us, and we cannot be responsible for errors in them, which we are always glad to have corrected. It may be added that this appears to have been another case where re-railing guards would have been appropriate and useful.—ED. ENG. NEWS.]

## Notes and Queries.

SEVERAL INQUIRERS are informed that the "Three Essays on Trackwork" published by the American Society of Railway Superintendents, as received in competition for the prize offered by them, and noticed in our issue of June 21, can be obtained through C. A. HAMMOND, Secretary, 350 Atlantic Ave., Boston, Mass.

WATER-WORKS asks: Will you kindly state in your next issue the maximum deflection in inches per length of 12 ft., allowable for laying water-mains around curves, for sizes of 12, 10, 8, 6 and 4 ins.? How is the calculation made of the effect of pressure to open the joints, and how should they be secured against such contingency while being laid?

Such pipe can be laid around a pretty sharp curve especially by cutting pipes, but we do not recall any established rule in regard to it. Perhaps some of our readers can refer to or suggest such a rule to conform to good practices.

H. F. P., of Ottawa, Canada, asks: Is there any book from which, given the nominal HP. of an ordinary non-condensing engine, I can determine all the leading dimensions of a multi-tubular boiler or battery of boilers to effectually operate the same?

It being possible to design almost an infinity of different boilers to operate any engine, it is not possible to answer from any book the question as put; but it is possible from many books, as from D. K. CLARK'S "Manual for Mechanical Engineers" to determine what HP. any given boiler is likely to suffice for. "Steam," published by the Babcock & Wilcox Co., of New-York and Glasgow, contains much information which may be useful to our correspondent.

L. A. asks: I have heard of some steps having been taken on some system of electrically worked street railroads, by which on a descending grade the motors can be used as dynamos to replenish the supply of electricity. Can you in your column of "Notes and Queries" tell me where to obtain information on this subject?

[The Beverly & Danvers (Mass.) Street Ry., which uses the Stevens storage batteries operates a line which has several long, steep grades. On descending the hills, the driver turns off the current and, after the descent has begun and the armature of the motor is revolving through the motion of the car due to gravity alone, connects the cells to the motor, now acting as a dynamo. It is stated that 14% of the electricity necessary for a single trip is generated in this way.]

B. W. L. writes: In your issue of Aug. 30 H. E. B., Bay City, Mich., enquires whether any riveted draw spans longer than 260 ft. exist in the United States.

The bridge carrying the St. Louis, Ark. & Texas Ry. over the Red River at Garland City, Ark., is a riveted draw—*i. e.*, the chords, both top and bottom, are solidly riveted together throughout. The bottom chord of the draw span is 300 ft. long from end to end. It is carried by a single central cylinder pier 24 ft. 10 ins. in diameter, which was considered at the time it was built to be the largest single cylinder pier in the country. I am speaking here from memory. I have a partially complete plan of the sub-structure of the bridge, but it is not obtainable just now.

The bridge carrying the same road over the Arkansas River at Rob Roy is, I believe, still longer, but I am unable to speak of that. Both bridges were built in 1882-83, C. F. STEPHENS, Chief Engineer.

S. A. asks: Will you oblige by naming the best and most complete works on sewerage, and the price of the same?

The standard book in English is Latham's "Sanitary Engineering," of which, however, it is now impossible to obtain copies, either in the original London edition or the American reprint published by ENGINEERING NEWS. This work contains a full account of the whole field of sewerage engineering without, however, treating of sewage disposal. The book by Julius W. Adams, on "Sewers and Drains for Populous Districts" (price $2.50), is excellent as far as it goes, but it does not treat of the separate system. This omission, however, is supplied by Staley & Pierson's "Separate System of Sewerage" (price $2.50), a second edition of which work is now under preparation. Col. Waring's "Sewerage and Land Drainage" (price $6), contains a full description of the Waring sewerage system. There is a great scarcity of standard works on this subject, and if any engineer wishes to obtain the thanks and dollars of his colleagues, he has only to write a really good book on sewerage and sewage disposal.

## Blowing Up of Basin Wall at the Royal Albert Docks.*

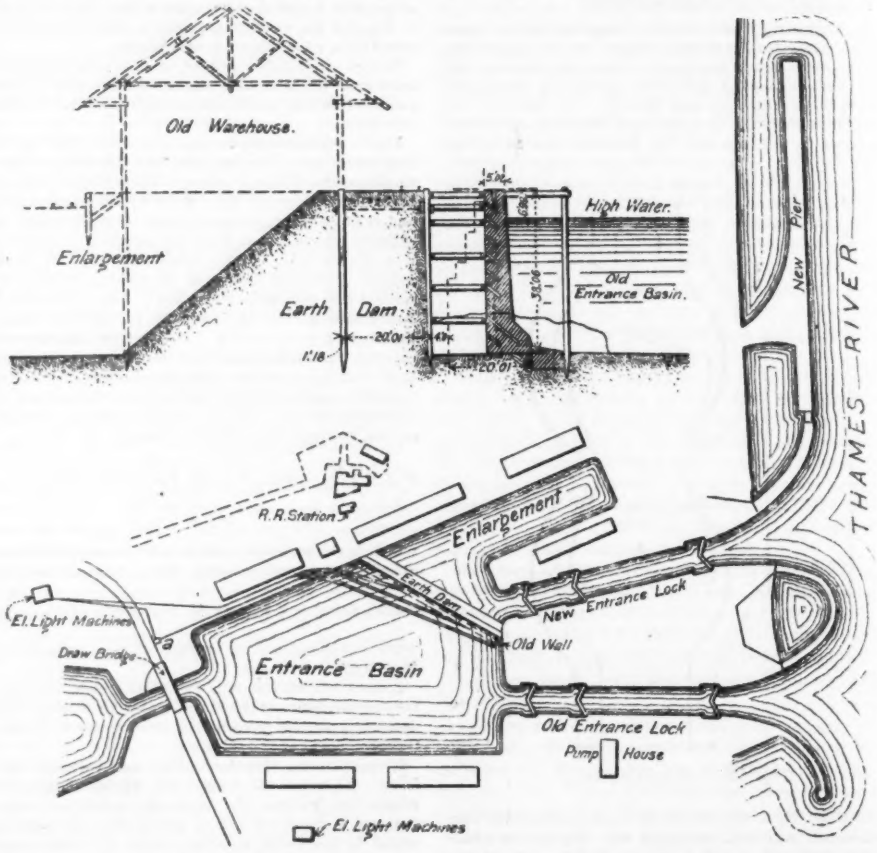
The basin, which it was found necessary to enlarge, was surrounded on all sides by walls 38 ft. deep, 20 ft. wide at the bottom and 5 ft. at the top, made of concrete, composed of 6 parts gravel and 1 part Portland cement, equal to granite in hardness and strength. The ground was made up to the level of these walls and quays and warehouses formed thereon. To effect a junction with the old and new work it was necessary to remove a wall at the northeast corner of the basin 520 ft. long. To demolish this wall, without affecting the navigation of vessels in the basin, was considered a difficult and responsible task. Several schemes were proposed for carrying out this undertaking, three of which were as follows:

1. To complete the new extension and entrance and fill the works with water, leaving the wall standing till the last thing, with a bank of earth behind it 10 ft. wide, battering to the bottom of the new portion of the basin at a batter of 2 to 1, and then to demolish it by submarine blasting and diving operations; but as this would have taken 12 months after the lock entrance had been completed, and would have cost £30,000, it was not further considered.

2. To build a coffer dam in front of the wall about 550 ft. long, with two rows of sheet piling, filling the interior with clay; but the depth of water being so great, it would have taken an enormous amount of strutting, and would have entailed a great cost, as it would also have interfered with the navigation of vessels in the basin, and would have been liable at any time to be carried away by ships drifting in heavy winds, and in the event of any such thing happening it would have been extremely disastrous to the works, therefore this scheme was also abandoned.

3. (The scheme which was designed and carried out by the writer): To drive a line of whole-timber sheet piling 14 ins. square, about 4 ft. from the back of the bottom of the wall, and a second row of piles 2 ft. back from the front row and 12 ft. apart, to act as tie piles, with a line of waling passing along near the top and on the front of the sheet piling, and another line of waling along the back of the tie piles, the whole being connected together with tie rods 2 ins. in diameter and 9-in. cast-iron washers. There were several reasons for driving these lines of piles, some of which are as follows, viz.:

1. That, had the trench at the back of the wall been timbered with ordinary poling boards, walings and struts, the timbering would have been carried away by the blasting during the operation of thinning the wall, and the bank, then having no support, would have collapsed and filled the trench.




SECTION AND PLAN ILLUSTRATING METHOD OF REMOVING BASIN WALL AT ROYAL ALBERT DOCKS.

2. The line of sheet piling would form a wall against which the five rows of struts, that were placed 9 ft. 3 in. apart along the whole length of wall, could be bolted so as to strengthen the remaining portion of the wall against the great pressure of water in the basin; but these sheets were not put in until the excavation had been carried to a considerable depth.

3. The tie piles were required to help the sheet piling to sustain the soil pressure of the embankment after the wall had been removed, and so as to prevent the works being flooded.

When this work had been made secure, sinking operations at the back of the wall commenced, thinning the wall as the sinkage progressed.

The wall was 5 ft. wide at the top, and the front face had a batter of 1 in 27 for 25 ft. down, then 1 in 6 for 6 ft. further down, and then sloped 3 ft. forward at an angle of 45°. The back line of wall was vertical, but was thickened by 4 steps; the first step was 2 ft. wide and 7 ft deep; the last step was 2 ft. 4 ins. wide, but only 3 ft. 6 in. deep; the wall was then straight to the bottom, 18 ft. more. In thinning the wall, these 4 steps were removed, leaving the back face of the remaining portions of the wall perpendicular, and of an average width of about 6 ft.

For thinning the wall as above stated, the number of holes drilled was 3,127 = 11,765 lin. ft. The amount of explosive used for this work was: 1,900 lbs. of rock powder, 1,050 lbs. of compressed powder cartridges, 105 lbs. of Nobel's gelatine dynamite.

The holes for thinning the wall were bored vertically, of different sizes and lengths, as the occasion required. The reason why rock powder and compressed cartridges were used was, it was thought that gelatine dynamite being so powerful an agent, it would be liable to shake the remaining portion of the wall; but there was a small amount of gelatine used where the holes were damp and powder could not be used so easily or quickly.

The drainage of the space between the back of the wall and the sheet piling during the operations was most effectual and complete. A sump-well was formed at each end of the wall; at the bottom of each sump a 15-in. iron pipe was connected with the 15-in. earthenware pipe which carried the water to the main sump; each pipe was fitted with a 15-in. valve, so that if any accident occurred during the operation at the back of the wall these valves could be closed at any moment to prevent the works being flooded. Protecting piles were driven in front of the wall, with a waling running from end to end to prevent passing traffic from colliding against the wall during the progress of the work.

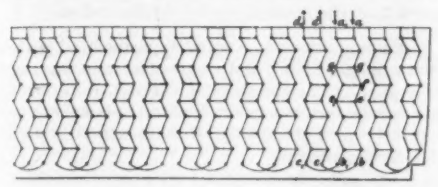
The greatest care had to be exercised, and the strutting between the sheet piling and the back of the wall had to be watched minutely, as the wall, after being thinned, could not take the pressure of water against it as before; and it was found by careful observa-

*A paper by Mr. JOSEPH THOMAS, M. Inst. C. E., Engineer of the Works, before the Institute of Marine Engineers.

tions with a theodolite that wet and dry weather acted considerably on the struts and ground, inasmuch as the struts and bank at the back sometimes gave as much as 2¼ ins., and we found that the wall in the center moved laterally in response to the contraction and expansion. A large quantity of water came through the cracks in the wall, but this was liable in a great measure to increase or decrease according to the movement of the wall. But the percolation of water through the wall was kept back by an apparatus with a sliding cover charged with breeze [A local English term for coal or charcoal dust, as nearly as we can determine.—ED.], and when lowered down opposite the leakage and the slide drawn the breeze was carried into the crack by the current, thus stopping the leak."

The scheme for demolishing the remaining portion of the wall has been exceptionally successful. As the sinkage at the back of the wall progressed, holes were drilled in the wall, partly by hand and partly by Ingersoll drills, 4 ft. apart, and alternately beneath one another at an angle of 45° towards the water in order to free the adjoining wal s at either end, by throwing the wall slightly forward, and to insure the wall being broken off at the ends; being tolerably straight, the wall was perforated by holes drilled 3 ft. 9 in. to 4 ft. long, as close together as possible on top and down the back of the wall in line with the face of the remaining wall. This precaution was necessary because the front face of the wall was much longer than the back, and hence to avoid the risk of a jam it was necessary that the first impulse should be in the direction of the greatest room.

The number of holes thus drilled for this final blast was 1,450 = 6,381 lin. ft., making the total number of holes drilled during the whole operation 4,577 = 18,146 lin. ft. So it is clearly demonstrated by the undermentioned facts, that by putting the holes 4 ft. apart at the angle of 45° and increasing the weight of the explosive from one-half of a pound at the top to three pounds at the bottom, according to the unit of work each charge had to perform, the calculation was well considered; but in the



Wiring Plan for Drill Holes in Front Part of Wall.

row of holes next to the bottom row there was a charge inserted of 6 lbs. to overcome the batter of the wall, and this charge had not only to do its proportion of work in breaking up the wall, but had also in a measure to counteract the direct action of the charges above it and tilt the wall forward. To allow this charge to have full force of the explosion, water was let into the ditch at the back to a height of 10 ft.; but had the ditch been entirely filled with water the hydraulic pressure against the wall would have thrown it so far forward into the basin as to have seriously interfered with the navigation, and would, therefore, not have deposited the *débris* into the very limited space allowed for it. Another reason why there was not more than the before-mentioned 10 ft. of water in the trench was to allow the inrush of water at the time of explosion to deposit the broken masses of concrete close to the face of the pile, and thus the navigation of ships in the basin would not be impeded.

After the explosion, sections by careful soundings were taken of the *débris* of the wall, and it was seen that it was deposited within a very limited area. It was also discovered that the whole of the wall was shattered to fragments, that very few pieces amounted to over ¼ ton in weight, and that the greatest part was broken so small that it was easily removed by ordinary dredging, thus fully justifying the anticipation, and conclusively proving by its success the correctness of the calculations. Although several buildings were within 70 ft. to 260 ft. of the scene of the explosion, none were damaged in the slightest degree, not even to the extent of breaking a pane of glass. The explosion, although simultaneous, caused very little vibration, and only slightly disturbed the water in the basin for the space of a few minutes, and the report was not louder than the quick firing of two or three Gardner guns, the sound of which, in fact, it very much resembled. The explosive used for the final blast was Nobel's gelatine dynamite, an explosive somewhat similar to and nearly as strong as blasting gelatine, and though it is one of the best and most powerful explosives known for this kind of work, the enormous quantity of 2,900 lbs. was used to overthrow the wall.

The fuses employed for exploding the charges were the ordinary Abel's high tension. Three thousand ohms was fixed for their resistance, and each one was carefully tested for that resistance before being used. The charges were made up as follows: A fuse with a detonator attached, containing 12 gr. of fulminate, and attached to 10 ft. lengths of gutta percha wire, was buried in a priming cartridge of gelatine of about 1¼ oz., and inserted in a waterproof bag closed at the orifice by an indiarubber bung, through which the wires were passed, the whole being made water-proof with indiarubber varnish smeared round the orifice of the bag closed with the bung. The wiring was necessarily very complicated, over a mile of main wire and two miles of branch wire being employed in connecting up the 1,500 fuzes. It was arranged in the following manner to the entire satisfaction of Sir F. ABEL, before whom the plans were laid.

Seventy-five parallels, each having 20 fuzes in series, were connected to two main wires run on insulators on the protecting timber before mentioned, these in their turn were connected in three places to the main wires from the engine house by wires carried under water in the basin, to guard against possible breaking of supply mains by an unequal explosion, and to insure the explosion of every fuze. Two series were taken off the main side by side, each supplying a perpendicular line of holes, and, to avoid the failure of a series through a faulty fuze, the two fuzes on each series were linked together by a short connecting wire which would bridge over the faulty fuze if it existed and insure the explosion of the remainder of the series. Great care was necessary in connecting up, because on account of the extreme sensitiveness of the fuses it was highly dangerous to test even with an ordinary galvanometer.

The effect on closing the circuit was remarkable; the entire visible length of wall was instantaneously lifted in the air in a perfect line about 6 ft.; a crackling roar, a cloud of brownish smoke and a violent surface displacement of the water in the immediate neighborhood of the wall were the only visible effects of the vast forces let loose below. So instantaneous was the effect that our chairman, who closed the circuit, declared the wall fell to pieces before his hand struck the switch. The writer superintended and carried out the work without a contractor.

## Varnish Tests.

At the late Master Painters' Convention, Mr. A. T. SCHROEDER, of the Chicago, Milwaukee & St. Paul Ry., presented the following interesting and practical notes of some recent tests of varnishes and varnishing methods on that road, which are interesting not only in themselves but as showing what important gains may result from a little attention to the varying quality of supplies:

Mr. J. N. BARR, our Superintendent of Motive Power, being of the conviction that it was the only way to arrive at conclusions in adopting standard material, instructed me to test all of our paint material, and, as varnish is one of the most important materials, it was concluded, in order to obtain the relative merits of the various varnishes, to finish every car, wherever practicable, with two varnishes; that is to say, one-half of the car with one brand, the other half with another brand, in such a way that every long side of a car should show the two varnishes as they meet in the center. Thus it would be plainly demonstrated by the material itself which of the two, in a certain length of time, would prove to be preferable.

From the fall of 1886 to the close of 1889 more than 200 cars were finished in this way, and altogether 17 different brands applied. It was clearly demonstrated that several of these, to put it mildly, were not at all adapted for that purpose, and they consequently had to be discarded; finally the brands were reduced to a limited number, and one of these, which had proved so far to be the best one in all respects, was put in competition with all the remaining ones. Up to now we have not arrived at a final conclusion, because of the many circumstances to be taken into consideration, but during my experience in testing varnish in this manner facts were revealed of which I never heretofore dreamed of.

Our standard for sleeping, dining and parlor cars is Pullman color; the ornamentation applied on the flat paint and the car then finished with one coat of rubbing and two coats of finishing varnish. Passenger, baggage, *et al.* cars are painted yellow, last coat varnish color, of the formula of 1 lb. paste body color, 1½ lbs. rubbing varnish and 2 oz. turpentine; then ornamented and finished with two coats finishing varnish.

At the suggestion of Mr. BARR we took a few cars and varnished them with one brand for the whole car, but used for one-half of the car one coat of rubbing and one coat of finishing varnish, and for the other half two coats of finishing varnish, in order to ascertain which process would give the best results. This was done accordingly. After a very short time the difference was so manifest that the one-half on which rubbing varnish had been used lost so much of its lustre that it showed a marked dividing line in the center of the car, and after a few months longer the contrast had so increased as to make it appear as though originally only one-half of the car had been varnished. Naturally such a car was immediately called in for revarnishing. On other cars which had to stay on the road from 16 to 20 months such difference could not be distinguished, as all lustre had disappeared, yet I observed that the half with the rubbing varnish over the gold was in a more advanced state of decay than on the other half, where two coats of wearing body varnish had been applied. Furthermore, a difference in favor of the latter was found when I applied the so-called oil test, of which I will make mention later on.

Now about these cars on which two brands were used, each car finished with two coats of wearing body varnish. In regard to the lustre it was very difficult to discover any difference, whereas on the yellow car it was found, after careful investigation, that some brands were superior in transparency. Yet I think this is only a matter of secondary consideration, as durability is certainly the most important object.

The oil test is as follows: After ten months of service a car arrives at the shop; both varnishes have the same appearance and surface, and no difference in the two varnishes can be noted. I then have a vial filled with half-and-half boiled and raw linseed oil, with a 2-in. long round wire nail, driven into the cork and extending into the oil. With this nail I take out a drop of oil and apply it on the varnish, making drops of various sizes so that I may be able to note how much if any of this oil will penetrate into, or spread out on, the varnish. After four or five hours I find that on the one varnish the oil has entirely penetrated and scarcely left a visible trace, whereas, on the other varnish the oil remains as applied, thus showing that no absorption whatsoever has taken place. Which of the two varnishes should have the preference? Which one will protect paint and wood best? I need not say.

On another car, one-half is in best condition, paint as well as varnish; but on the other half long cracks, running with the grain of the wood on the panels, draw through them, which, upon examination, are found to extend deep into the paint. Is the paint responsible for the cracking? I cannot believe so. The whole car was painted with the same paint at the same time and under like conditions. But, supposing that the whole car had been varnished with that one brand, would the painter not have to carry the blame? How could he prove the contrary? Who would believe him?

Of course, by testing varnish in this manner, many cars were utterly spoiled, and we had to remedy the evil as quickly as possible. It would be useless to recite the results of all of these various cases; suffice it to say, that it has brought to light many interesting facts, and although I was not able to examine all of these 200 cars, a great number of them enabled me, upon examination, to form a correct opinion as to the merits of the material.

## Committee on M. C. B. Standard Coupler.

A special M. C. B. Coupler Committee was authorized at the last convention of the Master Car Builders' Association, to be selected from the Executive Committe, to ascertain if the various automatic couplers of the M. C. B. type, which are now being manufactured and sold, conform to the standards of the Association. The Committee, appointed by the President, consists of Messrs. E. CHAMBERLAIN, J. N. BARR and E. W. GRIEVES, who are to carry out the details of the investigation and make their recommendations, as to the use of proposed templets and general instructions in the matter of conformity. This committee has just addressed the following letter to the manufacturers of the various couplers:

"The special committee appointed from the M. C. B. Association to ascertain whether the M. C. B. type of coupler now being furnished by the several manufacturers conforms with the standards of the association, and to submit a plan for the guidance of the association in the maintenance of these standards, would respectfully request that manufacturers of this type of coupler forward, on or before Nov. 1, 1890, at their own expense, freight or express charges prepaid, to Buffalo, N. Y., care of E. CHAMBERLAIN, Chairman of committee, a sample coupler and drawing or blue print of same, for examination by the committee. All sample couplers and drawings of same will be returned to owners immediately upon completion of committee's work."

THE LOCKS for the canal on the Canadian side of the Sault Ste. Marie river are making rapid progress. The appropriation for the entire work is $4,000,000. Ryan & Haney, the contractors, began work May 1, 1889, and have had 250 to 400 men employed ever since. The entire length of the canal will be 3,700 ft. The lock will be 600 ft. between the gates with a depth of 18½ ft. on the miter sill at low water mark. It will be 85 ft. in width from wall to wall, curving to a width of 65 ft. at the gates. The floor of the lock will be of concrete and the filling culvert will extend the entire length of the lock down the center. The gates and valves will be operated by hydraulic power. The gates will be of oak. The lock walls will be built of gray limestone, quarried near Amherstburg, Ont., and cut on the ground,

The banks of the canal will be lined with dry masonry.

A novel system of driving the machinery is being employed by the contractors. A flume taking water enough from above the rapids to furnish 1,500 HP., supplies water to 6 turbines, of which 3 drive the air compressors, one drives a pump by wire rope connection and the others drive the machinery of the carpenter, blacksmith and machine shops. The excavation is being done by derricks with 70 ft. booms set up at intervals of 120 ft. on each side of the lock pit. They are worked by compressed air and are so arranged that the same engine hoists the material and swings the boom. Each derrick handles 100 cu. yds. per day. The lock pit excavation will be finished about Oct. 1, but the laying of the lock masonry will not begin before next spring. The stone will be laid with a traveling derrick. About 700 to 900 men will be employed on the work next season.

IMPROVEMENTS TO THE CLEVELAND WATERWORKS are progressing as follows, the information having been kindly furnished us by Mr. JOHN WHITELAW, Superintendent and Engineer: There now remains to be driven, as originally designed, 700 ft. of the new 7-ft. tunnel begun in 1888. It has been proposed to extend this tunnel still further, making a total length of 4¼ miles [instead of about 1¾ miles], 3¾ miles of which would be under Lake Erie. The tunnel now being built under the Cuyahoga River is making good progress, one shaft and 120 ft. of the tunnel having been completed. So far good material has been encountered. The bottom of this tunnel is 70 ft. below the surface of the river. The tunnel has a horizontal diameter of 7.5 ft. and a vertical diameter of 7.66 ft. The shafts are 9 ft. in diameter and the length of the tunnel between centers of shafts is 511 ft. Both tunnel and shafts are being lined with 12½ ins. of brick masonry. The tunnel will carry a 40-in. wrought-iron pipe, connecting at each end with a new 36-in. cast-iron main.

TO INCREASE THE EFFICIENCY OF THE PHILADELPHIA WATER SUPPLY, it is urged by Director General WAGNER, before the Water Committee of the City Council, that $700,000 be expended, at a very early date, for replacing small mains with larger sizes; for the laying of a considerable quantity of 48, 36, 30 and 20 in. pipe, and for the purchase of two pumping engines of 10,000,000 and 20,000,000 galls. daily capacity, respectively. An ordinance is to be prepared authorizing a temporary loan of $700,000 at 3%, to be expended solely to meet the present demands of the Water Bureau.

TWO ENORMOUS EARTH DAMS are to be built by the Citizens' Water Co., of Denver, Col., a company organized in 1888 to furnish a public water supply to that city by gravity. The dams are to be located in the mountains, 17 miles southwest of Denver and two miles west of Wheatland. The dams will impound 9,500,000,000 galls. of water, the upper one impounding 6,000,000,000 over an area of 323 acres, at an elevation of 835 ft. above the city datum, and the lower 3,500,000,000 galls. over 150 acres, at an elevation of 735 ft. The dimensions of the lower dam are not stated in the description of these structures given in the Denver *Republican* of Sept. 14, but it is said that it will contain 1,750,000 cu. yds. of material, against 2,050,000 cu. yds. in the upper dam. The inner dam will be 275 ft. high, 680 ft. long on top, but 20 ft. long on the bottom, and 1,020 ft. through at widest part of the base. The area of the base, it is said, will be 18 acres. It will be of earth, puddled and rolled in 6 to 12-in. layers, with an inner slope of 2½ to 1 and an outer of 1½ to 1. Both slopes will be heavily paved, and will be terraced 10 ft. horizontally to 20 ft. vertically. The inner slopes, at least, will have a coating of 2 ins. of asphalt over the pavement.

WATER WILL BE DRAWN to the pipe leading to the city from a 4-ft. cast-iron pipe placed vertically in a shaft 12 ft. in diameter and 160 ft. deep. This shaft will be located in the bank at the north end of the dam, in solid rock. Water will be admitted from the reservoir to the shaft through tunnels 40 ft. apart, vertically. The immediate drainage area of the reservoirs is said to be but 6 sq. miles, but a 42-in. wood conduit will extend 12 miles to the north fork of the Platte River and tap a drainage area of 2,000 sq. miles. The conduit will have a daily capacity of 65,000,000 galls. Ample spillways will be provided at the dam, the water level being 15 ft. below the top of the embankment, where the dam is 90 ft. in thickness. The reservoir site is two miles from the Denver & South Park R. R., from which it is stated that a branch will be built to the reservoir and carried around its bed for some three miles. CHARLES P. ALLEN is Chief and J. D. S. HUYLER Consulting Engineer for this work.

THE DELAWARE RIVER IMPROVEMENT at Philadelphia is to be undertaken at once. The work consists in the removal of Smith's and Windmill Islands, necessitating about 17,000,000 cu. yds. of excavation. The total cost of the work is set at $3,000,000. The first contract for the work has just been awarded to the Penn Dredging Co., which was organized last June by PERCIVAL C. BELL, L. S. FILBERT, WM. J. LATTA and others.

THE ARMOR PLATE TESTS at Annapolis, Md., Sept. 18, resulted in a complete victory for the all-steel and nickel-steel pl tes made by Schneider & Co., of Creusot, France, over the compound steel and iron plate made by Cammell & Co., of Sheffield, England. Four shots, each weighing 100 lbs., were fired at each plate with a charge of 44¼ lbs. of American brown cocoa powder, giving an initial velocity of about 2,075 ft. per second and a muzzle energy of 3,342,876 ft. tons. The shots used were of the Holtzer chrome steel, armor-piercing, ogeeval-headed projectiles, of 6 ins. diameter, fired from a breech-loading rifled gun.

Each plate was 4 ft. high and 6 ft. wide. The Schneider plates were 10.5 in. thick and the Cammell plate 0.1 in. thicker. Each of the four shots fired at the Cammell plate passed entirely through it, breaking up the plate badly and penetrating deeply into the oak backing behind it. Every shot fired at the nickel-steel plate remained in the plate or rebounded, although the point of one shot entered the oak backing for a short distance. The all-steel plate stood the test remarkably well, all the shots but the first rebounding from it after penetrating some distance, and none of them succeeding in injuring the oak backing.

AN ERRATUM of some importance in Trautwine's pocket-book relating to the caution on p. 369, of editions from the 10th to the 14th (25th to 35th thousands) inclusive, and to Articles 2 and 3 on Centrifugal Force in earlier editions, may be obtained on application to the publishers or to JOHN C. TRAUTWINE, Jr.

VAST PETROLEUM DEPOSITS are again reported to have been found along the Athabasca River in the northwest territory of Canada. Mr. R. J. MCCONNELL, of the Dominion Geological Survey has been examining the district during the summer. Large quantities of bitumen have also been found. The government will probably sink wells to test the deposit. The Calgary & Edmonton railroad, an extension of the Canadian Pacific system, which is now being pushed to completion, will reach within 80 miles of the oil region.

A SURVEY OF THE SOUTH CAROLINA PHOSPHATE BEDS, which are owned by the State, is called for in the platform adopted by the Democratic State Convention.

PHOSPHATE DEPOSITS have been discovered in Southern Georgia. State Geologist J. W. SPENCER reports that a preliminary investigation shows that the outlook is good enough to justify further prospecting and development.

A SURVEY OF FLORIDA will be made soon by the U. S. Geological Survey. Maj. POWELL belives that the phosphate deposits in that State are of much greater extent than heretofore supposed and that a careful examination of the formations will reveal considerable mineral wealth of other kinds. It is to be hoped that the Major's engineers will also refute that worn out sarcasm about the land being so moist that the residents sell it by the gallon.

THE BASIC PROCESS is being experimented with at Chattanooga, Tenn., and a cast of 22 tons was made on Sept. 16. The commercial success or failure of this process means a great deal to the Southern iron industry, since practically all the Southern irons are high in phosphorus.

ELEMENTS OF WEATHER IN THE UNITED STATES, OF MOST INTEREST TO ENGINEERS, FOR THE MONTH OF AUGUST, 1890.
[Furnished to ENGINEERING NEWS by the Chief Signal Officer, U. S. A.]

| STATION. | Temperature. (Deg. Fah.) Average. | Max. | Min. | Range. | Wind. Velocity in miles per hour. Average. | Maxim. | Direction at time of max. velocity. | Precipitation.—Rain and melted snow. Inches. Total. | Heaviest in 24 hours. | Number of rainy days. |
|---|---|---|---|---|---|---|---|---|---|---|
| **NORTHERN CITIES.** | | | | | | | | | | |
| Northfield, Vt | 62.4 | 88 | 36 | 52 | 7.8 | 36 | S | 6.98 | 1.98 | 14 |
| Portland, Me | 66.0 | 88 | 49 | 39 | 7.6 | 36 | SE | 2.99 | 1.07 | 11 |
| New York City | 72.4 | 89 | 51 | 38 | 9.5 | 34 | S | 4.06 | 1 15 | 12 |
| Pittsburg, Pa | 71.1 | 94 | 45 | 49 | 3.8 | 24 | W | 4.06 | .96 | 12 |
| Chicago, Ill | 67.6 | 96 | 51 | 45 | 13.8 | 45 | S | 2.58 | 1.47 | 10 |
| Omaha, Neb | 71.0 | 99 | 48 | 51 | 6.8 | 28 | SE | 1.02 | .41 | 11 |
| St. Paul, Minn | 65.0 | 92 | 43 | 49 | 6.7 | 25 | NW | 2.20 | .67 | 12 |
| Duluth, Minn | 60.7 | 86 | 45 | 41 | 5.9 | 24 | NW | 3.62 | 1.13 | 18 |
| Bismarck, N. Dak | 66.8 | 103 | 40 | 63 | 10.7 | 46 | NW | 0.69 | .34 | 5 |
| Average | 67.0 | 92.8 | 45.3 | 47.5 | 8.1 | 33.2 | ..... | 3.13 | 1.02 | 11.7 |
| **SOUTHERN CITIES.** | | | | | | | | | | |
| Washington City | 74.0 | 95 | 49 | 46 | 6.0 | 33 | W | 5.50 | 1.73 | 17 |
| Louisville, Ky | 71.7 | 96 | 55 | 41 | 5.5 | 34 | SW | 4.18 | 96 | 12 |
| St. Louis, Mo | 74 7 | 97 | 54 | 43 | 8.8 | 33 | SW | 2.43 | 1.20 | 6 |
| Savannah, Ga | 78.6 | 94 | 63 | 31 | 5.3 | 22 | SW | 2.80 | 1.17 | 12 |
| Leavenworth, Kan | 74.2 | 98 | 55 | 43 | 4.7 | 28 | S | 5.85 | 2 70 | 13 |
| Jacksonville, Fla | 80.4 | 94 | 64 | 30 | 5.3 | 25 | S | 4.26 | 1.63 | 14 |
| Chattanooga, Tenn | 75.0 | 93 | 56 | 37 | 4.4 | 24 | SW | 5.15 | 1.73 | 17 |
| New Orleans, La | 80.6 | 91 | 67 | 24 | 4.8 | 36 | NW | 3.62 | 1.58 | 12 |
| Memphis, Tenn | 77.2 | 94 | 58 | 33 | 5.4 | 30 | SW | 7.56 | 2.63 | 12 |
| Palestine, Tex | 81.5 | 96 | 66 | 30 | 4.0 | 19 | NE | 2.05 | 1.56 | 3 |
| Average | 77.1 | 94.8 | 58.7 | 36.1 | 5.4 | 28.4 | ..... | 4.34 | 1 69 | 11.8 |
| **WESTERN CITIES.** | | | | | | | | | | |
| Helena, Mont | 67.0 * | 91 * | 45 * | 46 * | 7.0 * | 42 * | SW * | 0.23 * | 0.17 * | 4 * |
| Port Angeles, Wash | 61.4 | 85 | 50 | 35 | 10.7 | 36 | W | ..... | ..... | ..... |
| San Francisco, Cal | 72.9 | 100 | 50 | 50 | 4.4 | 36 | W | 0.79 | 0.58 | 5 |
| Salt Lake City, Utah | 69.0 | 95 | 48 | 47 | 6.2 | 35 | NW | 1.89 | 0.62 | 10 |
| Denver, Col | 89.2 | 110 | 68 | 42 | 6.8 | 42 | E | 0.83 | 0.53 | 8 |
| Yuma, Ariz | 67.2 | 88 | 47 | 41 | 5.4 | 25 | NE | 1.49 | 0.31 | 15 |
| Santa Fé, N. Mex | 71.1 | 91.8 | 51.3 | 43.5 | 6.8 | 36.0 | ..... | 0.87 | 0.37 | 7.0 |

* Report not received.

# CONSTRUCTION NEWS.

## RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

***Providence & Springfield.***—This company has located a branch from Primrose Station to Woonsocket, R. I.

***Cleveland, Akron & Columbus.***—This company has moved its general offices from Akron to Columbus, O.

***McKeesport & Belle Vernon.***—Right of way has been secnued for the proposed extension to Fayette, Pa., 14 miles.

***Columbus, Lima & Milwaukee.***—Work is making favorable progress on this Ohio railway. The ties are now being delivered alo g the line and tracklaying will soon begin

***Cleveland & Canton.***—The 6-mile connection between this road and the Columbus, Shawnee & Hocking R. R. is rapidly nearing completion. Tracklaying is in progress.

***Whitefield & Jefferson.***—Surveys are to be made at once for the extension from Jefferson to Berlin, N. H., with the intention of commencing construction at an early date.

***Maine Central.***—Work is making rapid progress on the extension of the Upper Coös R. R. from North Stratford, Vt., to Whitefield, N. H., 33 miles. The grading between Lancaster and Hazen is nearly completed, and the work of tracklaying has commenced.

***Grand Trunk.***—The surveys have been completed for the 5-mile cut-off from Blackwell to Sarnia, Ont ——It is stated that this company has purchased the Cincinnati, Saginaw & Mackinaw R. R., running from Durand to Bay City, Mich. It is possible that the road will be extended north from Bay City to Mackinaw.

***Canadian Pacific.***—A press dispatch states that at the October meeting of the directors of the Wabash Ry., that road will pass into the control of the Canadian Pacific Ry. Co.

***New York, Susquehanna & Western.***—During the next six months this company proposes expending $500,000 on improvements between Jersey City and Hackensack. A new iron bridge over the Passaic River at Riverside has just been completed, and a force of men is preparing the roadbed for laying the second track from Paterson to Hackensack, thereby giving the road a double track from Little Ferry Junction to Hackensack. The long wooden trestle between Little Ferry Junction and West End is to be filled in and made solid, and a two-truss iron bridge is to be built across the tracks of the New York & Greenwood Lake R. R., and Newark branch of the New York, Lake Erie & Western at West End, to take the place of the present wooden bridge.

***Baltimore & Ohio.***—This company, it is stated, has decided to build at once its branch from Fairchance, Pa., to Morgantown, W. Va. The surveys were made some time ago, and the right of way has all been secured. The work will include the construction of a $15,000 bridge at Morgantown.

***Toledo, Ann Arbor & North Michigan.***—A press dispatch says:

General Manager Ashley, of the Toledo, Ann Arbor & North Michigan, says that that road has been extended to within 20 miles of Traverse City, Mich., and has now a mileage of about 300 miles. The road is being rapidly pushed to Frankfort, Mich., where its terminus will be. Frankfort is on Lake Michigan, opposite Gladstone. The latter point is the Lake Michigan port of the Soo line, and the object is to make connection betwee the Soo line and the Toledo & Ann Arbor by running a steamboat line between Gladstone and Frankfort.

***Delaware, Lackawanna & Western.***—The grading is nearly completed and about 300 men are now at work on the Passaic & Delaware extension from Bernardsville to Peapack and Gladstone, N. J., 7¼ miles. Tracklaying has been finished for 5 miles and this section is now in operation. The grades are: 60 ft. per mile for 3 miles; 23 ft. per mile for 1 mile; 11 ft. per mile for ¾ mile, and 32 ft. per mile for the remainder of the distance. The largest bridge is 120 ft. long. The entire line is expected to be in operation by Oct. 15.

***Pittsburg, Shenango & Lake Erie.***—Work has been commenced upon the extension of this road to Lake Erie. The extension, which is 60 miles long, was partly graded some time ago, so that but little work remains to be done. It is expected that the line will be completed by Dec. 1. The rails and ties have been purchased and are now being delivered. The road will open up a fine coal and oil country. Samuel B. Dick, of Meadville, O., is interested.

***Herkimer, Newport & Poland.***—The syndicate recent'y organized to purchase the property and franchises of this company will take formal possession Oct. 1. The name of the new company is the Herkimer, Newport & Jack's Lake R. R. Co., and it proposes to change the 18 miles of old track from Herkimer to Poland, N. Y., to standard gauge and to build an extension to Jack's Lake. The object of the extension is to develop the lumber and ice traffic and to open up the region to the summer tourist travel.

***Pittsburg, Akron & Western.***—Wm. Semple, Jr., an official, is quoted as saying:

The work of construction on our new Western lines is going forward very rapidly, and we expect to have the Pittsburg, Akron & Western line in full operation by Dec. 1. The road extends from Akron, O., to Fort Wayne, Ind. At Akron it connects with the Pittsburg & Western from Pittsburg. We have completed and now have in operation 125 miles of the road. We are getting all of our locomotives from the Pittsburg Locomotive Works, and a large number of them are ready for service. The cars and other equipments we are getting from different sources. Some are from Pittsburg, and a number from Jeffersonville, Ind. The passenger stations and freight depots along the line are ready to receive traffic, so there will be no delay on that score. The road is already graded the entire distance. The surveys on our new line from Cleveland to St. Louis are all completed, and the work of grading is rapidly going ahead. That line will be called the Cleveland & Southwestern. My trip to New York was merely on private business matters connected with the road, and would be of no material interest to the public.

***Phillips & Rangeley.***—Six miles of track have been laid on this Maine road. About 400 men are now at work on the line, and 18 miles of the grading are completed. It is expected to have the first 16 miles in operation by Oct. 1. The road is 28½ miles long running from Phillips to Rangeley, Me. F. J. Ilsley, of Phillips, Me., is the engineer in charge of work.

Projects and Surveys.

***Lake Erie, Wooster & Muskingum Valley.***—An effort is being made to secure the construction of a railway from Wooster to Lodi, O., over the old partly-graded roadbed of this company.

***Providence, Panagansett & Springfield.***—The contract for building this road from Providence, R. I., to Springfield, Mass., is reported let to Coleman & Co., of Chicago. Work, it is stated, will commence Nov. 1. Engineers are now at work locating the line.

***Westerly & Jewett City.***—The projectors of this road have appointed and authorized a committee to make surveys for this road from Westerly, R. I., to Jewett City or Plainfield, Conn.

***Rondout Valley.***—This company, whose incorporation was noted in our last issue, proposes to construct a railway from Ellenville, N. Y., to Rosendale, N. Y., where connection will be made with the Walkill Valley R. R., a distance of 20 miles. Among the directors are Isaac N. Cox, of Ellenville, W. D. Stratton, of Middletown, and John C. Hornbeck, of Wawarsing.

SOUTHERN.—Existing Roads.

***Georgia Southern & Florida.***—About 700 men are now at work on the roadbed of the Macon & Atlantic R. R. L. R. Wright, the contractor, is pushing work on the extension to Thomasville, Ga.

***French Broad Valley.***—Work on this North Carolina road is now well under way. About 7 miles of the track have already been laid.

***Savannah, Griffen & North Alabama.***—Gen. E. P. Alexander, receiver of this railway, will offer the road, rolling stock, and all its franchises for sale at Griffin, Ga., Nov. 4. The road is 60 miles in length, and runs through the counties of Spalding, Fayette, Coweta, and Carrollton, Ga. The road is to be sold for not less than $500,000, $100,000 of which is to be paid to the receiver at the time of the sale, and the balance when the Spalding superior court has confirmed the sale.

***Louisville & Nashville.***—Surveys have been made for the proposed extension of the Birmingham Mineral R. R., from Oneonta, Ala., the present northern terminus of the Huntsville branch, to Guntersville, on the Tennessee River, and then across the river and along its northern bank in an easterly direction toward South Pittsburg, Tenn. The survey has not yet been completed in South Pittsburg. It is understood to be the intention of the company to build the Mineral extension from Oneonta to Guntersville, a distance of about 25 miles, at once. The contract for the construction of the Tennessee & Coosa, recently purchased by the Louisville & Nashville, has been let, and the road is now being built between Attalla and Huntsville. It will cross the Tennessee River at Guntersville and there the Mineral extension from Oneonta will connect with it, thus completing the line from Birmingham to Huntsville. The Mineral extension, it is stated, will not stop at Guntersville, but be built on without delay to South Pittsburg, Tenn., via Scottsboro, Ala., a distance of 50 miles from Guntersville.

***Cape Fear & Yadkin Valley.***—The grading has been completed on the extension from Mt. Airy, N. C., to the Virginia State line.

***Marietta & North Georgia.***—Surveys, it is stated, will soon begin for a branch from the main line near the Hiawasse River to Chattanooga, Tenn.

***Carolina, Knoxville & Western.***—Mass meetings are being held in the various towns along the route to vote aid to this road.

***East Tennessee, Virginia & Georgia.***—Preliminary surveys are being made for the extension from Mobile, Ala., west to a connection with the New Orleans & Northeastern R. R., near Pearl River, Miss.

***Western Maryland.***—Proposals for the construction of the Potomac Valley R. R., running from Williamsport to Cherry Run, Md., 14 miles, will soon be called for. The work will include a 650 ft. bridge across the Potomac River.

***Louisville Southern.***—Tracklaying on the Richmond, Nicholasville, Irvine & Beattyville R. R. has reached Richmond, Ky.

***Roanoke & Southern.***—A contract has been signed between this company and the city of Roanoke, Va., whereby that place is to be made the northern terminus of the road. The road is to run from Winston, N. C., to Roanoke, Va., 117 miles. About 37 miles of the line are now completed and 23 miles additional of the roadbed have been graded and 30 miles are under contract. Only 13 miles of the route remain to be located and as soon as this is done this portion will be put under contract.

***Paducah, Tennessee & Alabama.***—This road has now been completed from Paducah, Ky., south to the Tennessee State line, a distance of 73 miles. The contract for the section from the State line to Paris, Tenn., has been let to Johnson & Co. It is probable that this section will be completed during the year. The road is intended to run to Birmingham, Ala., ultimately.

***Atlantic Coast Line.***—Right of way is being secured for the line from Rowland to Fayetteville, N. C., 40 miles, and construction will soon begin.

***Macon, Dublin & Savannah.***—H. S. Morse, of Macon, Ga., Vice-President, writes as follows:

The grading is nearly completed on the section from Macon to Dublin, and tracklaying is now in progress. The work is generally heavy; maximum grade, 40 ft. per mile. There will be no large bridges. The route is through a fine cotton and timber country, and the principal business of the road will be in cotton and timber products. The Illinois & Georgia Construction Co. is building the road. The officers of the construction company are: Jno. T. Bright, Indianapolis, Ind., President, and Alex. C. Soper, of Chicago, Ill., is Treasurer. D. M. Hughes is President of the railroad company and D. B. Dunn is Chief Engineer. It is expected to have the section now under construction completed by Nov. 1. D. T. Rogers has the contract for bridging and Myrick & Bowman have the contract for the earthwork. The road when completed will run to Savannah, Ga., and its total length will be 165 miles.

***South Bound.***—Geo. Dole Wadley, Savannah, Ga., Chief Engineer, writes as follows:

This road is projected to run from Savannah, Ga., to Columbia or Sumter, S. C., a distance of 140 miles, of which 35 miles are in Georgia and 105 miles are in South Carolina. The first 35 miles from Savannah have been located and put under construction, 15 miles being nearly graded. About 400 men are now at work on this section. Tracklaying will begin Oct. 1. Louis McLain, of Savannah, is the contractor. There will be bridges across the Savannah and Congaree rivers. The route is through an agricultural section and agricultural products will form a large part of the traffic. The right of way has nearly all been secured and considerable local aid obtained from the towns along the route.

***Birmingham & Jones Valley.***—C. M. Boulden, of Birmingham, Ala., Superintendent and General Manager writes as follows:

This road is projected to run from Birmingham, Ala., via Avondale, Woodlawn, Trussville and Springville to St. Clair Springs, a distance of 30 miles. The route is through a thickly populated valley rich in coal and iron, and the road is expected to do a large suburban passenger business, and to obtain a heavy freight business from the furnaces along the route. The work will be easy; maximum grade 2%. The contract has been let to the Birmingham Construction Co., which has about 40 men now at work; two miles to Avondale being already graded. The surveys for the entire line are about completed. C. O. Lagerfelt, of Birmingham, Ala., is chief engineer.

***Norfolk & Western.***—J. R. Serpell has taken a large contract on the Ohio River extension of this road and will sublet a portion of the work. Address J. R. Serpell, Mouth of Pigeon, Logan Co., Ky.

Projects and Surveys.

***Opelika Terminal.***—A correspondent writes as follows:

A charter has been applied for to construct a railway from Anniston, Ala., through the counties of Talladega, Clebourn, Clay, Tallapoosa, Chambers, Lee, Russell, Barbour and Henry to some point on the Alabama Midland Ry The company has not yet been organized, but will be in about two months.

***Americus & Jacksonville.***—A project is on foot to build a railway from Americus, Ga., to Jacksonville, Fla. It is stated that surveys will be commenced at once. An application for a charter will be made at the next meeting of the Georgia Legislature.

***Auburn & Social Circle.***—It is reported that all the preliminary arrangements have been made for commencing work on a railway from Auburn to Social Circle, Ga., a distance of 12 miles.

***Harmon, Parsons & Rowlesburg.***—Chartered in West Virginia to build a railway from Harmon, Randolph Co., W. Va., to Rowlesburg, Preston Co., W. Va., a distance of about 50 miles.

***Chicago, Henderson, Bowling Green & Chattanooga.***—This road has been surveyed from Evansville, Ind., to Chattanooga, Tenn., and it is stated that work will commence soon.

NORTHWEST.—Existing Roads.

***Bladder Lake.***—A press dispatch says:

A new railroad to be owned and operated by Henry Sherry, is in course of construction from a point on the Wisconsin Central, 2 miles below Mellen to Sherry's mill, at Bladder Lake, a distance of 7 miles. S. C. Knowles, A. A. McPhee and L. E. Winterhalter are the contractors. They have a force of about 500 men employed, and expect to have the road finished before cold weather.

***Northern Pacific.***—A press dispatch says: It has been understood ever since the Northern Pacific acquired a Chicago line by leasing the Wisconsin Central that extensive facilities in the way of yards, belt lines, etc., would be acquired in that city as soon as possible. Work has finally been commenced, therefore, on the construction of a circle road extending from a point at Cicero directly west of the Grant locomotive shops, southwest to Twenty-second St., thence southwest to an intersection with the Illinois Central at Riverside Ave., thence due south 4 miles to Lyons, west from there to the Calumet Terminal R. R., then to Blue Island, north from Blue Island 7¼ miles to Seventy-fifth St., where it intersects with the Wabash R. R. and runs into the Dearborn St. station, thus making a complete circuit of the southwestern portions of the city. The contractors have agreed to have the road in running operation to Blue Island by

Jan. 1, 1891. The officials are using every effort to make the connection between Blue Island and the main line also by that time. At any rate, passengers will be landed at the Wisconsin Central station inside of a few weeks after Jan. 1. The company will also build numerous stations along the route, it being its intent to build upon the loop a great suburban traffic.

*Canadian Pacific.*—The Qu'Appelle, Long Lake & Saskatchewan R. R. has been completed to Prince Albert, N. W. T., and will soon be put in operation.

*Calgary & Edmonton.*—Tracklaying will commence on this road at once, and it is expected to have 100 miles completed this year. The force which is now at work on the Canadian Pacific extension to Prince Albert will be transferred to this road, and the work will be pushed. Already about 60 miles have been graded from Calgary north. Chief Engineer, Alex. Stewart, Calgary, Alberta.

Projects and Surveys.

*Duluth & Northern.*—This is the new name of the Duluth, Northwestern & Winnipeg R. R. Co., incorporated to build a railway from Duluth, Minn., northwest to the international line.

SOUTHWEST.—Existing Roads.

*Haines, Hamilton & Kingston.*—It is expected that tracklaying will begin on this road about Oct. 1, and that the line will be completed by Nov. 1. The road runs from Hamilton to Kingston, Mo., a distance of 8 miles. T. M. Long, of Kingston, is Chief Engineer.

*Missouri Pacific.*—The surveys for the extension of the Houston, Central Arkansas & Northern R. R. from Riverdale to Alexandria, La., have been completed. Henry Forrest & Co., of St. Louis, Mo., who have the contract now have a force of 800 men and 250 teams at work on the line. The clearing has been completed to the Little River, 20 miles north of Alexandria, and the grading has been finished from Riverdale to the Ouchita River.

Projects and Surveys.

*Arkansas & Gulf.*—Surveys are reported in progress from Arkansas City, south to the Louisiana State line, and construction will, it is stated, begin at once. President, W. B. Bergholz, 15 Cortlandt St., New York City.

*Kensington, Ga.*—About three miles of sewers have been projected by the Kensington Land Co., of Chattanooga, Tenn. G. L. Hogan is Superintendent of the company.

*Sherman & Northwestern.*—The committee on Indian affairs has reported favorably on the bill, granting this road right of way across Indian Territory.

ROCKY MT. AND PACIFIC.—Existing Roads.

*Rio Grande Southern.*—It is reported that surveys are in progress for an extension from Durango, Col., via Mancos Cañon to a connection with the Atlantic & Pacific Ry.

*Great Northern.*—About 1,000 men are now at work on the Seattle & Montana R. R. clearing and grading. Additional men are wanted.

*Pecos Valley.*—About 30 miles of track have been laid and 60 miles of grading completed on this road.

*Utah Central.*—President J. W. Young is reported to have secured the necessary money to construct the proposed extensions of this road. The offices of the company are at Salt Lake City, Utah.

*Oregonian.*—F. B. Staples & Co. have the contract for grading the extension from Coburg to Jasper, Ore., and are now contracting for men and teams. Work will commence at once, and it is expected to have the road completed to Springfield this fall.

*Denver & Rio Grande.*—The surveys for the Crested Butte branch have been completed and grading will be commenced as soon as the necessary arrangements can be made. The branch is 10 miles long and will open up extensive marble quarries.

Projects and Surveys.

*Jacksonville & Medford.*—The necessary money is reported secured to build a railway from Jacksonville to Medford, Ore.

*Los Angeles Terminal.*—This company has been organized by a number of St. Louis capitalists to build railway terminal facilities at Los Angeles, Cal. The company has purchased Rattlesnake Island, lying in San Pedro Bay, about 22 miles from Los Angeles, and will build wharves, warehouses, etc. From the Island railways will be built to Los Angeles, and from Los Angeles to the coal region of Southwestern Nevada. It is estimated that the terminal improvements at Los Angeles will cost $1,500,000.

*Peninsular.*—Colonel D. K. Allen, the engineer and land inspector of this company, is reported as making the following statement:

The Peninsular Railway Co. is an English company organized to build a railroad from San Diego, Cal., through to El Paso, and from San Quentin Bay in Baja, Cal., to Yuma, Cal. These two lines will use the same track from Ville Trinidad, in Baja, Cal., through to Mount Capimichi, where the line crosses the great salt and saltpetre beds of the Colorado Desert. The company will also build from San Quentin southeast to Los Angeles Bay on the Gulf of California, where the Tora Mining Co. has 2,000 men at work mining, and the San Juan Co. has 1,300 men employed, and are now putting on 300 more.

FOREIGN.

*Mexican Southern.*—The grading has been completed on the first section of this road from Pueblo to Tecumavaca, to Tehuacan, and the greater part of the masonry built. It is expected to open the line from Pueblo to Tehuacan this season.

*Mexican Northern.*—About 20 miles of grading have been completed on this road and work is progressing rapidly. The road is to be run from Escalon to Sierra Mojada, 85 miles. Vinton P. Safford, Escalon, Mex., Chief Engineer.

## CITY TRANSIT.

**Dummy Railway.**—*Anniston, Ala.*—A 6-mile line is proposed by a company now organizing.

**Inclined Railway.**—*Pittsburg, Pa.*—It is reported that a new inclined railway will be built to the top of Mt. Oliver, at an expense of $300,000.

**Horse Railways.**—*Philadelphia, Pa.*—The Union Passenger Ry. will lay a number of new lines.

*Rock Hill, S. C.*—The Rock Hill Land & Site Co. are reported as likely to construct a street railway.

**Elevated Railways.**—*New York City.*—The project of the New York City Suburban R. R. to build a railroad from the intersection of 154th St. and 8th Ave. through Macomb's Dam Road to Woodlawn Cemetery, with branches to High Bridge and Fordham Landing, has received the consent of a majority of the property holders along the line.

*Chicago, Ill.*—The Alley Elevated R. R. has been located and work will be pushed on it as much as possible. It is said that no further delays are expected and that the road will be completed as far as South Chicago and Pullman by the middle of next September.

**Electric Railways** are proposed at Baltimore, Md., address North Baltimore Passenger Ry.; Petersburg, Va., address T. Pannell; Newport, Ky.; Sioux City, Ia, address F. C. Henderson; Rockport, Tex.; Dallas, Tex., address Dallas Consolidated Ry.; Corvallis, Wash.

*Flushing, N. Y.*—The Westingbouse Co. has received the contract for the Flushing and College Point Electric Ry. The work must be completed by the middle of December or the contract will be forfeited.

*Amsterdam, N. Y.*—The lines of the electric railway will probably be extended as far as Hagaman's Mills and Akin.

*Astoria, N. Y.*—A. P. Sharpstein has offered to build a railway to Youngs Bay for a cash subsidy of $80,000. He will guarantee to begin work within 60 days, and complete it in 6 months, the subsidy to be paid within 5 days after the completion of the road.

*Trenton, N. J.*—The overhead trolley system has been approved by the city government, and will be adopted by the street railways.

*Atlanta, Ga.*—The Street Railway Co. has definitely resolved to adopt electricity on its lines. The system will not be chosen until after the Street Car exhibition to be held in Buffalo, N. Y., Oct. 15.

*Bristol, Tenn.*—The Southwest Bristol Land Co. may lay a line to its property. C. P. Cannon can give further information.

*Texarkana, Ark.*—The street railway will expend probably $40,000 on an electric plant for operating its lines.

*Houston, Tex.*—The Bayou City Street Ry. will adopt electricity for a motive power.

*Ogden, Utah.* The Henderson Co. has received permission to build lines in this city. The company is backed by A. S. Garrettson, of Sioux City, Ia.

*East Portland, Ore.*—A company has been formed to build a line to Sellwood and Milwaukee.

*Winnepeg, Man.*—A franchise for an electric line has been granted to R. C. Jefferson, J. Kasson, O. H. Thompson and others, who will begin construction at once and lay about five miles of track.

*New Companies.*—The New Rochelle Railway & Transit Co., New Rochelle, N. Y.; capital stock, $125,000; incorporators, T. E. Crimmins, C. Strauss, J. J. Walsh, of New York City, and others. Chilhower Street Ry. Co., Knoxville, Tenn.; incorporators, J. W. S. Frierson, S. S. Herrel, J. C. Luttrell and others. South Chicago Ave. & Jackson Park Street Ry. Co., Chicago, Ill.; capital stock, $100,000; incorporators, I. Holmes, D. J. Lake and C. D. Cole. San Diego Street Ry. Co., Chicago, Ill.; capital stock, $250,000; incorporators, E. O. Russell, F. H. Russell and L. Perfitt. Ann Arbor, Ypsilanti & Detroit Street Ry. Co., Detroit Mich.; capital stock, $100,000. Leavenworth, Kan., Electric Street Ry. Co.; capital stock, $500,000; incorporators, S. F. Neely, J. Hannon and Robert Garrett. Peninsula Electric Ry. Co., Tacoma, Wash.; capital stock, $500,000; incorporators, F. C. Todd, T. O. Abbott and A. S. Santrick.

## BRIDGES, TUNNELS AND CANALS.

**Bridges.**—*Maine Central R. R.*—This company will replace the iron bridge across the Saco River, at Hiram, by a new one.

*Indianapolis, Ind.*—The Union Ry. Co. will build a viaduct over Louisiana St. to cost about $150,000 or $200,000.

*Washington, D. C.*—The following bridge bills have passed the Senate:

Senate bill to authorize the construction of a bridge across the Ocanee River in Georgia. House bill to authorize the Chicago, Henderson, Bowling Green and Chattanooga R. R. Co. to construct a bridge over Green and Barren rivers in Kentucky. Senate bill to authorize the construction of a bridge across the Kentucky River and its tributaries. House bill to amend the act of July 16, 1889, authorizing the construction of a bridge across the Red River of the North.

*Charlotte, N. C.*—The Richmond & Danville R. R. will replace the present bridge across the Yadkin River by a new iron one.

*Georgia.*—A bridge is to be built by the counties of Berrien and Worth, jointly, across Little River at the Overstreet ferry.

*Middlesborough, Ky.*—D. N. Mason will receive bids until Oct. 1st for the construction over Yellow Creek canal of an iron bridge 100 ft. wide, 60 ft. long, 60-ft. roadway, and with two 20-ft. sidewalks.

*San Antonio, Tex.*—Bids will be received for an iron bridge Oct. 4. Bryan Calligan, Mayor.

**Tunnels.**—A bill has been introduced in the House of Representatives in Washington by Mr. Covert, of New York, to authorize the construction of a tunnel under the bay of New York, between Staten Island and Brooklyn. The bill authorizes the New Jersey & Staten Island Junction R. R. Co. to build a tunnel under the bay from Middletown, S. I., to New Utrecht, L. I., for the passage of railroad trains. The tunnel is not to interfere with the navigation of water craft and shall be placed at a sufficient depth below water that a safe archway may be constructed therein to preserve the currents and channels of the bay. The tunnel shall be a post route, with a right of way to the United States for postal telegraph purposes.

## WATER-WORKS.

NEW ENGLAND.

*Antrim, N. H.*—Surveys have been made for a system of water supply. A committee appointed in March to ascertain the expense of putting in works has the matter in charge.

*Canaan, N. H.*—The contractors will soon begin the construction of the new works.

*Greenville, N. H.*—Pipe-laying is progressing rapidly under the supervision of J. Hammond Elliott.

*Meriden, Conn.*—About 3,000 ft. of 8-in. pipe will be laid to connect the water from Twiss Pond with the Broad and Pratt Sts. mains.

*Milford, N. H.*—A vote was taken on Sept. 17 upon the proposition to buy the existing works.

*Somerville, Mass.*—An appropriation of $8,000 for extensions has been made.

*Springfield, Mass.*—Contractor Stanton has been awarded the contract for excavating for laying the new pipe at 22 cts. per cu. yd. A 36-in. cast-iron pipe will be used to connect the small basin with the main reservoir. The R. F. Hawkins Iron Works has started to make the 54-in. wrought iron conduit pipe for the west side of the reservoir.

*Winchester, Mass.*—The following is from E. Worthingloupe, Resident Engineer:

The South Reservoir dam, begun in 1882-3, and then temporarily abandoned, is being completed. The dam is of earth, with masonry core, curved in plan, and is about 900 ft. long. When filled the water surface of the reservoir will have an area of 160 acres at an elevation of 188 ft. above mean sea-level. The engineer is Percy M. Blake, Hyde Park, and the contractors are Rowe & Hall, Boston.

MIDDLE.

Attention is called to an advertisement in another column offering for sale an established system of waterworks now in successful operation.

*Brooklyn, N. Y.*—A 20-in. main is to laid through the Seventeenth Ward, to supply the citizens of Greenpoint and vicinity. Estimated cost $12,000. Contractors, Harris & McGuire.——Specifications are being prepared by Chief Engineer Van Buren for the construction of a water tower on Mount Prospect, at a cost of $65,000, and for laying a 48-in. water main from the Ridgewood reservoir, with 36 and 30-in. branches, at a cost of $400,000.

*Ellicottville, N. Y.*—The reservoir has been completed and pipe-laying is progressing rapidly.

*Lancaster, N. Y.*—A water company has been organized by Frederick H. James, C. J. Coatsworth, J. G. Miller and others to build water-works.

*New York, N. Y.*—The Aqueduct Commissioners have awarded the contract for building the earth and masonry work of the auxiliary dam of Reservoir D, at Carmel, to M. S. Coleman at $83,092.58.

*Rochester, N. Y.*—The Jackson & Woodin Mfg. Co. has been awarded the contract for furnishing the pipe for the extensions recently ordered at $25.86 per ton.

*Schenectady, N. Y.*—The Water Commissioners have been trying for some time to find an adequate and suitable supply of water. Test wells were first sunk on the flats beyond the Mohawk River and at Schermerhorn's millpond, but these were unsuccessful. A report of the Commissioners dated Sept. 8, describes the tests made recently to determine the quantity of water which could be drawn from Sanders Lake. These tests were made under the direction of the Commissioners and Superintendent Ingersoll, and independent tests by Prof. Chas. C. Brown, of Union College. The available supply was found to be less than the present consumption, and the investigations will be pursued along other lines.

*Bridgeton, N. J.*—T. Woodruff, Superintendent, informs us that it is probable that an additional well or basin will be dug for the collection of ground water, but that no definite action has been taken. [The note which appeared in our last issue as "Bridgeton, N. J.," referred to this place.—Ed.]

***Huckensack, N. J.***—By the proposition of the Hackensack Water Co., of Hoboken, the borough is offered a water supply at about $15 per hydrant. Councilmen Alyea and Warner and two citizens are to investigate the plan, and report to the Council.

***Madison, N. J.***—Moffett, Hodgkins & Clarke, of Syracuse, N. Y., have been awarded the contract for constructing the new works. The contract price is $56,925.

***Philadelphia, Pa.***—Director Wagner has addressed the Water Committee of the City Council on the subject of increasing the efficiency of the water supply. He recommends the laying of 8,000 ft. of 48 in., 8,100 ft. of 36 and 30 in. on Fifty-second St., 24,000 ft. of 30 in. from the Frankford pumping station to the Wentz farm station, and about 20,100 ft. of 20 in. pipe. He also asked for an extra pumping engine of 10,000,000 galls. daily capacity for the Roxborough station, and one of 20,000,000 galls. daily capacity for the Spring Garden station. Total estimated cost of improvements, $700,000. The committee has ordered an ordinance prepared providing for a temporary loan of $700,000 at 3% for carrying out these plans.

***Pittsburg, Pa.***—The Pittsburg *Press* states:

The repeated demands of citizens of the South Side upon the Monongahela Water Co. for a better supply of water having proved unavailing, it has announced that a new Citizens' Water Co. is to be organized. Knoxville, Allentown, Beltzhoover and Mt. Oliver are the localities in which it is proposed to operate. Members of the Birmingham Land Improvement Co. are among the most prominent of the promotors of the scheme. Right of way has already been secured from the township authorities to run an inlet pipe from the Monongahela River, above Beck's run, up through the township to Southview Place, where the reservoir is to be located. It is proposed to fix the capital stock at $200,000. Fifty-two of the South Side citizens are now interested in the scheme. They say they mean business.

### SOUTHERN.

***Berryville, Va.***—The Berryville Water Co. invites proposals for the construction of water-works until Oct. 15. Bids are to be accompanied by plans and specifications. Address T. S. Thomson, Secretary.

***Norfolk, Va.***—A new 10,000,000-gall. pumping engine will probably be purchased.

***Roanoke, Va.***—Extensions and improvements are proposed by the water company.

***Morganton, N. C.***—J. A. Shiping has sent us the following information:

The Morganton Water Supply & Street Railway Co. will soon commence work. Water will be conveyed from a mountain stream by gravity to tanks and a reservoir. The 15 hydrants, valves, etc., have not been purchased. There will be 5½ miles of mains. The estimated cost is $25,000. Annual hydrant rental, $750. The officers are: President, W. E. Walton; Secretary and Treasurer, J. A. Shiping. Engineer, W. E. Walton. Population, 1,800.

***Columbia, S. C.***—The committee appointed to investigate the water supply states in its report that they are considering the question of bringing water from Gill's Creek and also the purchasing of a filter. A final report with recommendations is yet to be submitted.

***Darlington, S. C.***—C. S. McCullough, G. W. Brown and I. Lowenthal are the incorporators of the new company.

***Greenville, S. C.***—The Paris Mountain Water Co. has been granted a charter by the Secretary of the State for supplying this city with water for fire protection, domestic use and manufacturing purposes. The incorporators are: William S. Perot, of Conshohocken, Pa.; Joseph S. Keen, Jr., and H. Bayard Houge, of Philadelphia; F. M. Broke and J. W. Hawley, of Media, Pa. The principal place of business will be at Philadelphia.

***Atlanta, Ga.***—Engineers Hall Bros. have completed surveys for bringing the water supply from the Amicola and Soque rivers. To utilize the former as a source of supply it is proposed to construct an open canal, to be 1,400 ft. above tidewater at its source, 7 ft. wide, and have a fall of about 3 ft. to the mile. The source of the proposed canal, to lead from Soque River, would be 1,374 ft. above tide-water, and about 100 miles long.

***Rome, Ga.***—The East Rome Water Co. has been awarded the contract for supplying the city with water.

***Anniston, Ala.***—The water company is extending its mains through Corning Highlands.

***Eustis, Fla.***—Regarding the projected works, we have received the following from P. A. Ross, Mayor:

Wright, Hazzard & Co. will probably build the new works. Estimated cost, $50,000. Water will probably be pumped from the lake to a stand-pipe. Population, 1,200.

***Shelby, Ala.***—Marigold & Co., of Atlanta, Ga., will soon begin the construction of the new works. The supply will be furnished by two springs.

***Water Valley, Miss.***—Secretary M. D. L. Stephens has sent us the following:

Contracts will not be let before October, and work will probably be commenced about Nov. 1. The city proposes to issue bonds and construct and own the works. Estimated cost, $5,000. Water will be pumped from a deep well to a tank. Mayor, W. A. Hering; Chairman Water Board, S. B. Hering. Population, 3,000.

***Morristown, Tenn.***—Plans for works will be made by Edward D. Bolton, 44 Broadway, New York. Construction will be commenced at once.

***Clinton, Tenn.***—Henry Clear is President and C. J. Sawyer, Secretary, of the Electric Light & Water Co., recently incorporated. Capital stock, $100,000. A charter has been granted to the company, and construction work is to be commenced soon. Water will be taken from a large spring.

***Morristown, Tenn.***—We have received the following:

Harris & Co., of New York, will construct the new works. E. D. Bolton is the Engineer in charge. The contract for furnishing 40 hydrants as well as the necessary valves has been awarded to the Eddy Valve Co., of Waterford, N. Y.

***Newport, Ky.***—Bids for reconstructing and repairing the reservoir have been received as follows:

P. Murray & Son, Cincinnati, O., $43,429; John Cloherty, Newport, $45,570.

### NORTH CENTRAL.

***London, O.***—The third of the supply wells has reached a depth of 30 ft.

***Xenia, O.***—The National Water Supply Co., Cincinnati, O., is procuring a water supply for the Ohio Soldiers' and Sailors' Orphans' Home by means of its steamed filter wells or underground reservoir system to replace a filter gallery which has become impacted and contaminated.

***New Albany, Ind.***—Work on the new 20,000,000-gall. reservoir has been commenced. It is being done under the supervision of Frank Scheffold, C. E. About 6,000,000 brick will be required.

***Kalkaska, Mich.***—We have received the following from George R. Catten:

Contracts will be let on Sept. 25. Work is to be commenced on Sept. 30, and completed in June, 1891. The works will be built and owned by the city. Estimated cost, $160,000; to be procured by issuing bonds. Hydrants will be used. Water will be taken from a well and probably supplied by gravity direct to mains. Population, 1,500.

***Duquoin, Ill.***—Drilling for a water supply has been commenced by the water company. About 8 miles of pipe and 50 to 100 hydrants will be used this season. Estimated cost, $60,000.

***Monticello, Ill.***—City Clerk Reber Huston has sent us the following:

Contracts will be let on Oct. 14. Work is to be commenced on Oct. 25 and completed as soon thereafter as possible. No estimate of the cost has been made. Bonds will be issued by the town. The present intention is to pump water from an artesian well to a tank and use it for fire protection and domestic use. Population, 1,800.

### NORTHWESTERN.

***Armour, Ia.***—The town has voted to issue bonds for sinking an artesian well and building water-works. Sealed bids for the bonds will be received by the Town Board until Sept. 25, at which time bids or propositions for sinking the well will be opened. It is expected that operations will be commenced by Oct. 1.

***Creston, Ia.***—H. Birkinbine, Engineer for the new works, has sent us the following information:

The works are to be completed by Nov. 1. The Creston City Guarantee Water-Works Co. is now "in market" for hydrants, valves and boilers. The 2,500,000-gall. pumping engine will be furnished by the Barr Pumping Engine Co. Water will be pumped to a stand-pipe and direct to mains. Therewill be 8 miles of cast-iron mains and 90 hydrants. Cost, $85,000. The officers are: President, H. S. Clark; Secretary, John Gibson; Treasurer, J. B Harsh. Population, 9,000.

***Estherville, Ia.***—A. O. Peterson informs us that a vote was taken on Sept. 16 on the question of constructing works.

***Topeka, Kan.***—The Topeka Water Co. has introduced an ordinance offering to make improvements costing $350,000, provided the city will pay for a certain number of hydrants.

***Atkinson, Neb.***—The contract between the city and Meals & Godfrey for constructing a water-works plant has been signed and work will proceed at once. The works are to be completed by Jan. 1, 1891.

***York, Neb.***—The water-works have been sold to T. A. Post, of St. Louis.

***White Sulphur Springs, Mont.***—Propositions will be considered on Sept. 22 for furnishing the town with water.

### SOUTHWESTERN.

***Camden, Mo.***—The John J. O'Brien Boiler Works will furnish the water company with a 175-ft. stand-pipe.

***Terrell, Tex.***—An artesian well will probably be sunk for increasing the water supply.

***Denver, Col.***—Property-owners on Prospect Hill—a suburb embracing Boulevard place, Argyle and Summit—are organizing an artesian well company, and subscriptions to stock are already more than enough to warrant the prosecution of the work. It is expected that it will be necessary to sink to the depth of from 650 to 750 ft. The general design contemplates the providing of pumping-works with a 30 HP. engine, building a supply tank or basin, the laying of water-mains, etc. The projectors expect to begin operations within 30 days. Among those prominently identified with the plan are: Captain Culter, W. D. Ladd, Dr. Morehouse, W. B. Thompson, C. F. Bedell and others.

***Trinidad, Col.***—We have received the following information from J. M. John:

The city will issue $150,000 of 5% 15-year bonds and build works. Contracts will be let on Oct. 15, and work is to be commenced on Nov. 15 and completed by July 1, 1891. The supply will be taken from the Las Animas River. For further information address N. W. Wall. No engineer has been employed as yet. Population, 6,014. [Works were built in 1879 by the Trinidad Water-Works Co.—ED.]

### PACIFIC.

***Astoria, Ore.***—Captain Flavel is reported as stating:

To bond the city for $250,000, as would be necessary, would swamp us. Beside, we have no one here capable of managing such a big concern. What little we have now is mismanaged by men who have nothing at stake. I think we should give a franchise to outside capital, and even if it does cost a little more for a few years, it will be cheaper in the long run.

***Port Angeles, Wash.***—The following is from T. J. Patton, City Clerk.

Construction work was commenced on Sept. 15, and is to be completed by Dec. 1. Water will be supplied by gravity from Ennis Creek. The works are being constructed by the Port Angeles Water Co. President, R. F. Schwartz; Vice-President, J. R. Dwyer; Secretary and Treasurer, I. Salbinger. Engineer, Benezette Williams, of Chicago, Ill. Population, 2,000.

***Spokane Falls, Wash.***—Plans and specifications for a new reservoir and larger distributing mains are being prepared by Huber, Hough & Trumbull, of this city.

***East Portland, Ore.***—Plans for the distribution system of the East Side Water Co., are being prepared by Engineer T. M. Hurlburt. The Oswego Iron Works has been awarded a contract for 900 tons of cast-iron pipe. An order for the new pumping machinery will probably be place this month.

***Moscow, Idaho.***—A certificate of increase of the capital stock of the Lewiston Water and Light Co. has been authorized, and by a written consent of the company the capital stock has been increased from $30,000 to $100,000.

### CANADA.

***Portage La Prairie, Man.***—Another water tank is to be erected in the west end of the town for additional fire protection.

***Winnipeg, Man.***—Propositions will be received until Oct. 15 for making available the water power of the Assiniboine River. The city now invites tenders from parties desiring to construct and own the works and power, subject to a minimum of 400 HP. required by the city for water-works and electric light purposes. The total minimum power available at the lowest water is about 2,000 HP. and at ordinary low water 5,000 HP., which may be increased by the construction of additional works to 10,000 HP. Joshua Callaway is Chairman Special Water Power Committee.

## ARTESIAN WELLS.

It is reported that wells are to be sunk in the following places:

Darien, Ga.; Rochelle, Ga.; Callahan, Fla.; Boerne Tex.; Claude, Tex., A. T. Levy, of Denver, Col.; El Paso, Tex., R. T. Hill.

## IRRIGATION.

***Tarpon Springs, Fla.***—The Tarpon Springs Irrigation and Development Co. has been incorporated. Capital stock, $250,000, with privilege of increasing it to $1,000,000. The incorporators are: A. P. K. Safford, John B. Walton and W. K. Decker & Co., of Tarpon Springs; George B. Johnson, J. C. Fromme, George B. Creveling and F. A. Davis, of Philadelphia.

***Leavenworth, Kan.***—Alexander Caldwell has filed a charter incorporating a big irrigating enterprise, recently started in Idaho. It is known as the Caldwell Real Estate & Water Co., and has been formed to construct and maintain dams and canals for water-works, irrigation and manufacturing purposes. The capital stock is $100,000. The directors are: Howard Sebree, Montie B. Gwinn, Henry D. Blatchley and Sherman M. Coffin, of Caldwell, Ida.; and Alexander Caldwell, P. A. Caldwell and Henry C. Fields, of Leavenworth.

***Culbertson, Neb.***—The Culbertson Irrigating and Water Power Co. has been incorporated with a capital stock of $200,000. The incorporators are: C. J. Jones, Garden City, Kan., and A. W. Bond and E. C. Smith. Eastern capitalists.

The Culbertson Lake dam and about four miles of the canal have been completed. The dam is 30 ft. high. The canal will be 40 miles long, and have an average width of 30 ft.

***Denver, Col.***—The directors of the Boulder and Larimer County Irrigating and Mfg. Ditch Co. have filed papers certifying to an increase of stock from $3,000 to $9,000.

***Nevada.***—Surveys are being conducted on the Truckee and Carson rivers with a view of building reservoirs where the flood water can be stored.

## SEWERAGE AND MUNICIPAL.

**Sewers** have been ordered at Buffalo, N. Y., 3, 2½, 2¼ ft. brick and 20, 18 and 12-in. pipe; Newark, N. J.; Pittsburg, Pa.; Washington, D. C.; Columbus, O; Cincinnati, O.; Madison, Wis.; Duluth, Minn.; Denver, Colo.; Los Angeles, Cal.

***Montreal, P. Q.***—Assessment rolls for sewers in 11 streets have been prepared.

***Chicopee, Mass.***—The town authorities have decided to lay 1,610 ft. of 24-in. Akron pipe.

***Harrison, N. J.***—This city, which is one of the most unhealthy in the State, will probably put in a complete sewerage system. The plans proposed by the City Council and its engineers have been submitted to the residents at a public meeting, and were approved.

***Pittsburg, Pa.***—Assessments for a $53,252 sewer have been ordered.

***Charleston, S. C.***—City Engineer Barbot has sent in his plans to the City Council for a sewerage system on the tidal drain principle. The outfalls all end in gates which can be closed at low tide. About half an hour before high tide one gate is opened, allowing the water to rush into the pipes. At the expiration of 2 hours the same gate is again shut and the water in the drain is kept in

until 1 hour before low tide; then another gate is opened and the water rushes out, beginning with a velocity due to a 4-ft. head, and in 2 hours the drains are entirely emptied.

*Duluth, Minn.*—Assessment rolls for building 2 sewers at an estimated expense of $37,914 have been prepared.

Grading has been ordered at Cincinnati, O.; Duluth Minn.; St. Paul, Minn.; Los Angeles, Cal.

Paving has been ordered at Lincoln, R. I.; Providence, R. I, asphalt and granite; Rochester, N. Y., Medina sandstone and asphalt block; Buffalo, N. Y., asphalt and Medina sandstone; Montgomery, Ala.; Columbus, O., grading and paving with asphalt, granite or brick; Cincinnati, O., macadamizing; Madison, Wis., macadamizing; St. Paul, Minn., cedar block on plank foundation; Clifton Ia, macadamizing; Armourdale, Kan.

*Melrose, Mass.*—The Town Treasurer has been authorized to buy a stone crusher. The authorities think it will be cheaper to break their own stone for macadamizing, and will purchase a ledge and erect the crusher before April 1, 1891.

*Albany, N. Y.*—Asphalt pavement costing $28,875 and granite block pavement costing $43,930 has been ordered.

*Newark, N. J.*—Notices of intention to pave a number of streets with trap, granite and asphalt have been issued.

*Washington, D. C.*—The Citizens' Association has recommended grading, regulating and asphalt paving at an estimated cost of $217,500.

*Duluth, Minn.*—Assessment rolls for grading and paving, at an estimated cost of $63,032, have been prepared.

*Salt Lake City, Utah.*—Grading, curbing, paving with asphalt, and laying cement sidewalks. A. F. Doremus. Sept. 27.

Bonds.—*Lynn, Mass.*—Bonds for $30,000 will be issued for street improvements.

## ELECTRICAL.

Electric Light.—Plants are proposed at Springfield, Vt.; Glasgow, Va., address the Rockbridge Co.; Tacoma Va., address the Land Improvement Co.; Buena Vista, Ga.; Hawkinsville, Ga., address O. A. Horne; Piedmont, Ala.; Greencastle, Ind.; Sandwich, Ill.; Howell, Mich.; Cherokee, Ia.; Georgetown, Colo.; Sanger, Cal.; Walla Walla, Wash.

*Hamburg, N. Y.*—The Water & Electric Light Co. will probably purchase an electric light plant very soon. Their power house is now finished.

*Elizabeth City, N. C.*—The Albemarle Land Co. desires prices on an electric plant with capacity for fifty 30 c. p lamps.

*Clinton, Ia.*—An electric light and motor company has been organized with a capital of $100,000, and will at once proceed to erect a plant.

*Albina, Ore.*—The following bids are reported as having been received for lighting the city with electricity: From the Albina Light & Water Co., for each incandescent lamp of 16 c. p., $2.50 per month; 20 c. p., each, $2.75 per month; arc lights, 2,000 c. p., each, $15 per month; the term of lighting not to be less than 5 years. From the Edison General Electric Co., Pacific northwest district: Arc lights of 2,000 c. p., each, $14 per month; incandescent lights, 20 c. p., $2.85 per month; 16 c. p., $2.70 per month.

*Puyallup, Wash.*—A company with a capital stock of $35,000 has been formed here to buy and run an electric light station.

Welding Machinery for England.—The Thomson Electric Welding Co. is reported as having received orders from England for 16 plants of capacities ranging from wire to 2-in. shafting.

Electric Drills.—Earle's shipyards at Hull, Eng., are reported as using electric drills on 2⅝ in. holes through 2¼-in. steel decks on H. M. S. "Endymion" and "St. George." The Royal Dockyard at Devonport, allows 2 men half a day to drill holes that are electrically finished in 21 minutes at Hull.

The Lechner Electrical Mining Machine, which is manufactured at Pittsburg, was put to a severe test at the mines of Capt. S. Brown, near Boston, on the Youghiogheny River recently, and is reported an unqualified success. In 5 minutes the machine cut through a solid piece of coal 3 ft. wide and 4 ft. 7 ins. deep.

New Companies.—Gillette Electric Gate Co., Chicago, Ill.; capital stock, $1,000,000; incorporators, H. and R. F. Gillette, E. L. Prussing. Burt Electric Light, Fuel and Power Co., Chicago, Ill.; capital, $5,000,000; incorporators J. L. and A. S. Bennitt, M. C. Burt. Delphos, O., Electric Light and Power Co.; capital stock, $40,000. Citizens' Electric Light and Power Co., Houston, Tex.; capital stock, $50,000. Howell, Mich., Electric Light and Power Co; capital stock, $10,000. Citizens' Electric Co., Dayton Ky.; capital stock, $25,000; Sec'y, C. Bird. Portage la Prairie, Man., Electric Light Co.; capital stock, $20,000. Pocomoke, Md., Electric Light and Power Co.; capital stock, $10,000; Sec'y, F. H. Dryden.

## CONTRACTING.

Manilla Rope.—*New York City.*—The Dock Dept. recently received bids for manilla rope at prices ranging from 14.3 to 16 cts. per lb. for 9,000 lbs. of 3-in., 1,350 lbs. of 3½-in. and 1,700 lbs. of 5-in.

Sewers.—*St. Louis, Mo.*—The bids for constructing the sewers in district 4 have all been rejected as too high by $40.000 at least. The lowest bid was that of Heman & Fruin, amounting to $241,255.

Dam.—*New York City*—The contract for the auxiliary dam at reservoir *D* of the new Croton Aqueduct has been awarded to M. S. Coleman at $83,093.

Paving.—*Albany, N. Y.*—The Barber Asphalt Paving Co. recently received a contract at $3.10 per sq. yd. for asphalt, 80 cts. per lin ft. for curbing, 35 cts. per cu. yd. for filling, and 25 cts. per cu. yd. for excavation.

*Rochester, N. Y.*—Recent bids for laying 4,570 sq. yds. of asphalt roadway were all at $2.75 per sq. yd.

*St. Paul, Minn.*—W. C. Doherty has received a $31,400 contract for paving with cedar blocks on plank foundation.

Levee Building.—*St. James, La.*—Recent bids ranged from 17.94 cts. to 21.5 cts. per cu. yd.

## PROPOSALS OPEN.

Street Work.—*New York City.*—Grading and paving with trap block. Dept. Public Parks. Sept. 24.

*West Troy, N. Y.*—Constructing roads at Watervliet Arsenal. Lieut.-Col. F. H. Parker. Sept. 27.

*Rochester, N. Y.*—Asphalt and Medina stone paving. T. J. Neville. Sept. 26.

*Newark, N. J.*—About 5,400 sq. yds. of granite block paving and 3,800 cu. yds. of embankment.

*Staunton, Va.*—Macadam road. G. B. Dandy, U. S. A., Quartermaster's Office, Washington, D. C. Oct. 11.

*Fort Logan, Colo.*—Flagging for 2,895 ft. of sidewalks. Capt. L. E. Campbell, Denver, Colo. Sept. 25.

Street Railway Construction.—*Cincinnati, O.*—Double track line with all turnouts, etc. E Henderson. Oct. 2.

Sewers.—*New York City.*—Brick and pipe sewers in rock cuts. Dept. of Public Parks. Sept. 24.

*Troy, N. Y.*—E. O. Ross. Sept. 23 and 27.

*Cleveland, O.*—C. G. Force, City Eng. Oct. 9.

*Columbus, O.*—F. M. Senter. Sept. 23.

Breakwater.—*Gray's Island, N. B.*—A. Gobiel, Ottawa. Sept. 30.

Drinking Fountains.—*Brantford, Ont.*—Water Commissioners.

Water Power.—*Winnipeg, Man.*—Proposals for developing the water power of the Assiniboine River at this place. A mininum of 400 HP. must be furnished the city for light and power purposes. At least 10,000 HP. are available. J. Callaway, Oct. 15.

Canal Work.—*Albany, N. Y.*—Dredging 40,000 cu. yds. of earth at Albany basin of Erie Canal, improving several stretches, excavation along canal amounting to 47,500 cu. yds. in earth and 13,520 cu. yds. in rock, and considerable embankment and masonry work. E. Hannon, Oct. 6.

Mortars.—*Washington, D. C.*—Thirty-five 12-in. mortors. Separate proposals for furnishing the bodies and assembling the parts. Brig. Gen. S. V. Bennet, Ordnance Dep't, Oct. 7.

Steam Boilers.—*Wahsington, D. C.*—Sectional Water Tube Boilers for Capitol Bldg. E. Clark, Oct. 4.

Steel Armor Piercing Shot.—*Washington, D. C.*—Furnishing 8 and 10-in. steel armor-piercing shot. Brig. Gen. S. V. Bennet, Oct. 7.

Heavy Machinery.—*Watervliet Arsenal, N. Y.*—One 80-ton traveling crane, 12-in. gun lathes and other machine tools. Lieut. Col. F. H. Parker, Ordnance Dept, U. S. A., Oct. 8.

Fire Proof Shop.—At National Armory, Springfield, Mass. Col. A. R. Buffington, U. S. A., Oct. 10.

Hotel.—*Clifton Forge, Va.*—Hotel on the Clifton Forge Co.'s property. B. D. Avis, Oct. 1.

Shaping Machine.—*Washington, D. C., Navy Yard*—A 14-in. shaper. E. Stewart, Paymaster Gen. U. S. N. Sept. 30.

Hoisting Engine.—*New York City.*—Engine of 10 HP., also boom derrick. O. B., 320, *Herald* office.

Grading.—*Brooklyn, N. Y.*—On the grounds of the Contagious Disease Hospital, Flatbush, L. I. J. J. Adams. Sept. 29.

## MANUFACTURING AND TECHNICAL.

Cars.—The Pullman Works have sent 25 passenger cars to the Illinois Central R. R. within the last month, and have 15 more to deliver under the same contract.

Locomotives.—The Rio Grande Western R. R. has placed an order for 8 freight locomotives with the Baldwin Works and for 4 passenger engines with the New York Locomotive Works. H. K. Porter & Co. have orders for a number of light engines to be used in the silver lands of Chihuahua, Sonora and Durango, Mexico.

New Rolling Stock.—The contracts for new rolling stock for the Denver & Rio Grande R. R. are let to the following firms: Baldwin Locomotive Co., for the locomotives, the Peninsular Car Co., of Detroit, for the freight cars and the Pullman Palace Car Co., for the passenger coaches. The estimated cost of the entire lot is $1,384,159. The following is a list of the equipment: 200 standard gauge coal cars, 2 standard gauge Shaffer snow plows, 1 standard gauge business car, 7 standard gauge switch engines, 13 standard gauge 10-wheel passenger engines, 28 standard gauge consolidated freight engines, 19 standard gauge first-class passenger coaches, 10 standard gauge second-class passenger coaches, 9 standard gauge combination baggage and express cars, 4 standard gauge mail and express cars, 23 standard gauge cabooses, 1 standard gauge wrecking derrick car, 1 standard gauge wrecking tool car, 5 standard gauge combination mail and express cars (changed from narrow gauge), 16 narrow gauge dump cars, 1 standard gauge steam excavator, 13 standard gauge construction cars, 3 standard gauge low flat cars with cook house, 100 standard gauge low flat cars, 100 standard gauge box cars, 200 standard gauge low flat cars and 100 standard gauge stock cars.

The Berlin Iron Bridge Co., will design and erect the new paper mill at Madison, Me., of the Manufacturing Investment Co., of New York City. The buildings will consist of a digester house, 220 × 62 ft., 4 stories high, a machine shop, 172 × 72 ft., and a 2-story washing house. 182 × 74 ft. The works will be the largest of the kind in this country and will be located in the heart of the wood pulp district. The Berlin firm will also design and build a new casting shop for the Midvale Steel Co. The building will be 285 × 135 ft. and constructed entirely of iron. There will be 2 wings of 50 ft. each, and through the center of the building there will be runways for two 50-ton traveling cranes. The same company will build the plant of the Lake Erie Engineering Co. at Buffalo, N. Y. The machine shop will be 185 × 108 ft. and the foundry building, 225 × 108 ft. The buildings were designed by F. Feikel of Cleveland, O., and will be completed ready for occupancy by Jan. 1, 1891.

Metal Market Prices.—*Rails*—New York: $30.00; for old iron rails, $25.50 to $26. Chicago: $33.50; old rails, $26.50 to $26.75 for iron, $18.50 to $22 for steel. Pittsburg: $31 to $32; old rails, $28 to $28.25 for iron; $21.50 to $22 for steel.

*Foundry Pig-iron.*—Chicago: $15.50 to $17.50. Pittsburg: $16.25 to $17.50. New York: $16 to $18.

*Track Materials.*—New York: steel angle bars, $1.80 to $1.95; spikes, $2.20 to $2.25; track bolts, 2.95 to 3.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.15 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2 to 2.1 cts. for iron; spikes, 2.2 to 2.25 cts; iron track bolts $2.85 with square, and $3 with hexagon nuts.

*Pipe.*—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

*Lead.*—New York, 4.55 to 4.65,cts.; Chicago, 4.85 cts.

*Structural Material.*—Pittsburg: angles, 2.25 cts.; tees, 2.8 to 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.65 to 2.7 cts.; universal mill plates, 2.35 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.1 to 3.2 cts. for flange; 2.9 cts. for shell, 2.5 to 2.55 cts. for tank. New York: beams, 3.10 cts.; plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts. Chicago: angle, 2.35 to 2.4 cts.; tees, 2.9 to 3.0 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.


## Important to Dredge Manufacturers and Dredging Contractors.

OFFICE OF BOARD OF HARBOR COMMISSIONERS OF HAVANA, CUBA.

It being decided by said Board to provide the port of Havana, Cuba, with a complete dredging plant by competition, dredge manufacturers and contractors are hereby invited to present bids for same.

Proposals can be forwarded either in English or Spanish.

The dredging plant to consist of one screw marine dredge machine, 150 to 180 HP. of 75 kilogrammeters indicated in the piston (embolus).

This apparatus must be self-propelling.

Five dump scows with capacity of 80 to 100 cubic meters.

One screw tug boat, 75 to 100 HP. of 75 kilogrammeters indicated in the piston (embolus).

The dredge machinery, as well as that of the tug boat, must be of the "Compound" system.

Competitors must be able to furnish security amounting to at least 5% of total cost.

For full particulars and specifications apply to the Secretary of the

SPANISH CHAMBER OF COMMERCE,
88 Wall Street—Room 20. Office hours from 11 to 4.

38-1t. SERAFIN SANCHEZ, Chairman.

## Notice to Contractors.

Proposals for macadamizing several streets will be received by the Village of Mt. Vernon, N. Y., up to Sept. 30. Plans and specifications can be seen at office of Commissioner of Public Works, Mt. Vernon, N. Y.

JARED SANDFORD,
38-2t Village President.

## To Grading Contractors.

Sealed proposals will be received at the office of the City Clerk, City Hall, Lawrence, Mass., until three o'clock P.M. of Wednesday, Oct. 1, 1890, for the removal of a portion of Gale's Hill. Approximate quantity to be moved, 125,000 cu. yds. Material a sandy gravel.

Further information and specifications at the City Engineer's Office, City Hall, Lawrence.

JOHN W. CRAWFORD, Mayor.

38-1t

## Notice to Contractors---Sewers.

SEALED PROPOSALS for the construction of sewers and appurtenances in Prospect St. from Chestnut to Walnut St.; High St. from Valley to Prospect St.; Bellevue St. from Maple to Prospect St.; Elm St. north from Main St.; South Main St. from Main to the "Oaks," will be received by the undersigned at the office of Geo. W. Melony, of the Borough of Willimantic Conn., until eleven o'clock, of the 29th day of September, 1890, at which hour the bids will be publicly opened and read.

Each proposal shall be signed by the bidder, and accompanied by a certified check for $500 payable to the order of the Borough of Willimantic as a guarantee that the bidder will execute the contract within the time specified in this notice, in case the bid be accepted.

The person or persons to whom the contract may be awarded will be required to appear with the sureties offered by him or them, and execute the contract within five days from the day of the award, and in case of failure or neglect so to do he or they will be considered to have abandoned it, and as in default to the Borough of Willimantic.

The proposals must be made upon blanks furnished by the sewer committee.

The form of agreement, specifications and all information may be obtained at the office of Geo. W. Melony.

The engineer's approximate estimate of work and materials, by which the bids will be compared, is as follows:

Trenching and laying complete 3,000 linear ft. 6 in. vitrified pipe sewer; 1,200 linear ft. 8 in. vitrified pipe sewer; 500 linear ft. 24 in. vitrified pipe sewer.

Furnishing materials, except iron work, and building complete 14 manholes.

The right to reject any or all bids is reserved, if deemed for the interests of the Borough.

JOHN M. HALL,
E. S. BOSS,
GEO. W. MELONY, } Sewer Committee.

WM. G. SMITH, Engineer. 38-1t

## To All Whom it May Concern.

*Whereas*, the Common Council of the City of Dunkirk, at a regular meeting thereof, held at the Council Room, in said city, on the 16th day of September, 1890, did resolve to macadamize the roadway in that part of Central Avenue lying between Third street and Fifth street to the width of forty (40) feet, together with the necessary curbing, guttering and crosswalks, excepting such portions thereof as are occupied by the Dunkirk and Fredonia Street Railroad Company;

*And whereas*, said Common Council did at the same time and place direct the City Clerk to advertise in the city paper and in some general contractors' paper, for bids for the materials and labor necessary for the carrying on of such improvement;

*Now, therefore*, Take notice, that any and all persons desiring or willing to furnish the necessary materials for the said improvement, and to do the said work, are hereby invited to make proposals therefor, and seal them, and deliver them to the undersigned at his office in said city.

*Also, further*, Take notice, that any person desiring to bid on said work and materials, by application to the expert civil engineer, George D. Baker, Dunkirk, N. Y., will be furnished with complete specifications, showing the work to be done, the materials to be furnished and the form and manner in which such work must be done and the materials used.

The bids must be delivered to the undersigned on or before Friday, Oct. 3, 1890, at 7:30 o'clock P. M., at which time such bids will be opened and read in public by the Mayor and Common Council assembled.

The Common Council reserves the right to reject any and all proposals.

Dated Dunkirk, N. Y., Sept. 18, 1890.

38-1t EDWARD MADIGAN, City Clerk.

## To Masonry Contractors.

AMERICUS, GA., Sept. 16, 1890.

Bids will be received for the construction of four (4) brick piers, with pile foundations, on the Savannah, Americus & Montgomery Ry., till Oct. 10.

Apply for plans and specifications to

J. C. WRIGHT,
38—2t Engr. in Charge.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

# The Anniston Pipe Works,

MANUFACTURERS OF

## CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

*Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently*

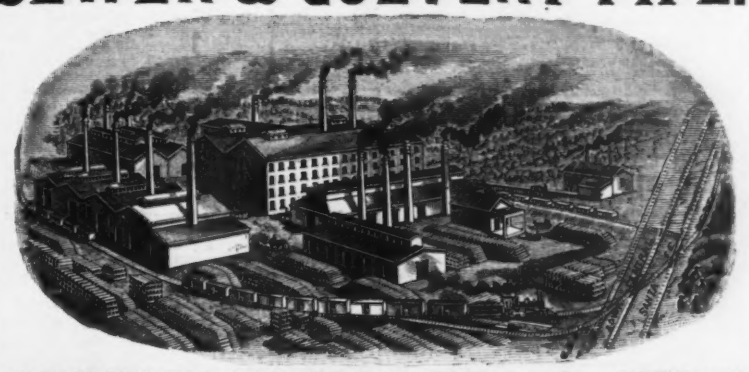
THE NEW PULSOMETER STEAM PUMP.

*without Engine, Machinery, Oil, Expensive Power, Skilled Labor, or Material Wear. Send for Illustrated Catalogue.*

PATENTED U. S. AND CANADA.

PULSOMETER STEAM PUMP CO., 120 Liberty St., New York.

## DOUBLE STRENGTH SEWER & CULVERT PIPE.



## MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

## To all Whom it May Concern.

*Whereas*, The Common Council of the city of Dunkirk at a regular meeting thereof, held at the council room in said city on the 16th day of September, 1890, did resolve to Macadamize the roadway in that part of Lion St. lying between Third and Fourth Sts, to the width of forty (40) ft., together with the necessary curbing, guttering and cross-walks, excepting such portions thereof as are occupied by the Dunkirk and Fredonia St. R. R. Co.;

*And whereas* said Common Council did at the same time and place direct the city clerk to advertise in the city paper and in some general contractors' paper for bids for the materials and labor necessary for the carrying on of such improvement.

*Now, therefore*, Take notice that any and all persons desiring or willing to furnish the necessary materials for the said improvement and to do the said work, are hereby invited to make proposals therefor and seal them and deliver them to the undersigned at his office in said city.

*Also, further* Take notice, that any person desiring to bid on said work and materials, by application to the expert Civil Engineer, George D. Baker, Dunkirk, N. Y., will be furnished with complete specifications showing the work to be done, the materials to be furnished and the form and manner in which such work must be done and the materials used.

The bids must be delivered to the undersigned on or before Friday, Oct. 3, 1890, at 7:30 o'clock P. M., at which time such bids will be opened and read in public by the Mayor and Common Council assembled.

The Common Council reserves the right to reject any and all proposals.

EDWARD MADIGAN, City Clerk.

Dated DUNKIRK, N. Y., Sept. 18, 1890. 38-1t

## Proposals for Iron Bridge.

Sealed proposals will be received at our office until 2 P. M. Saturday, Oct. 4, 1890, for the erection of an iron bridge on West Fifth Ave., in this city, in strict accordance with the specifications and drawings, copies of which can be seen in the office of the City Engineer. Bids will also be allowed upon plans which shall be in accordance with the general specifications, but no bid will be accepted except from bridge manufacturing companies. The right is reserved to reject any and all bids.

BOARD OF PUBLIC WORKS,
38-2t, Knoxville, Tenn.

## Proposals for Grading, Improving and Macadamizing County Roads, in the County of Richmond.

Sealed proposals will be received at the place of meeting of the Board of Supervisors of Richmond County, N. Y., at the Village Hall, Stapleton, S. I., until Monday, Oct. 13, at 3:30 P. M., as follows:

For grading and otherwise improving county roads in accordance with maps, profiles and specifications on file in the Engineer's office. The quantity of work to be done is as follows:

TELFORD PAVEMENT.

| | |
|---|---|
| Total length, miles | 29 7 10 |
| No. square yards, pavement | 195,000 |
| No. cubic yards, excavation | 71,000 |

REPAIRS TO MACADAMIZED ROADS.

| | |
|---|---|
| Total length, miles | 3 8-10 |
| No. square yards, repairs | 65,000 |
| No. cubic yards, broken stone required | 3,600 |

TRAP OR GNEISS BLOCK PAVEMENT.

Old New York blocks can be used.

| | |
|---|---|
| Total length, miles | 1 9-10 |
| No. square yards, pavement | 35,250 |
| No. cubic yards of excavation | 7,000 |

Plans and specifications and also the conditions under which said proposals or bids shall be received, may be examined at the office of William S. Bacot, Engineer of County Roads, Old Village Hall, Stapleton, S. I.

Printed copies of the specifications and contract and also conditions under which said proposals or bids shall be received, may be had at the office of aforesaid Engineer.

The right to reject any or all bids for said work is reserved by said Board of Supervisors of Richmond County, as may be deemed for the best interests of the County, and notice is hereby given that the bids will be publicly opened at the meeting of the Board of Supervisors, to be held at the time and place above given.

By order of the Board of Supervisors.

CHARLES M. TODD,
Dated Sept. 15, 1890. Clerk, *pro tem*,
P. O. Address, Tompkinsville, S. I.
38-3t

## Notice to Contractors for Water Works Plant.

OFFICE OF THE COMPTROLLER,
CITY OF ALLEGHENY, Aug. 7, 1890.

Sealed proposals will be received at this office until 12 o'clock noon Wednesday, October 1, 1890, for doing the following work viz.:

PUMPING ENGINES.

For the construction and erection of two pumping engines of a capacity of 8,000,000 gallons each, to be of the type known as the vertical direct-acting three-cylinder compound condensing engines, with a combined capacity of pumping 16,000,000 gallons every 24 hours against a head of 300 feet, with a piston speed not exceeding 120 feet per minute.

RESERVOIRS.

For the construction of two basins having 460 by 660 feet surface at foot of embankments, said embankments to be 30 feet above bottom of basins. The reservoirs to have one inlet and one outlet gate chamber.

STOP GATES.

For furnishing six sixty-inch stop gates, to be doubled seated, with parallel-faced valves of easy adjustment, to be operated with two screw stems parallel to each other, and connected by suitable gear.

BOILERS.

For a 1,500 horse-power boiler plant; boilers to be set up in batteries not exceeding 300 horse power, with a given guarantee on evaporative power of boiler per pound of coal consumed. Boilers will be placed in position and set up by the contractor on foundations furnished by the city.

FILTERING PLANT.

Proposals will be received for the construction and erection of a filtering plant to be used in connection with new water service, to be erected at a point nine miles up the Allegheny River Bidders to furnish their own plans and specifications, erect their plants, and operate the same for a period of not less than six months on trial, and if satisfactory to the Committee on Water and Superintendent of Water-Works, the contract price to be paid; if not satisfactory, they to remove the plant without cost to the city.

CONDUIT AND FORCE MAINS.

For the construction and laying of a 60-inch steel or iron conduit from Nine-Mile island to the city, about 8.74 miles, to be in sections of 24 ft. in length from center to center of joints. Manholes to be provided for every 40 sections of water main. Elbows for vertical and horizontal inclinations to be provided for, with angles as shown on plan and profile. Force main to be fifty (50) inches in diameter, and constructed as per plans and specifications.

Plans and specifications for buildings, reservoirs, conduit force mains and delivery pipe will be furnished by the city.

Bidders will furnish their own plans and specifications in full detail for engines and boilers, and their connections, with necessary plans for foundations for same.

Proposals will be received for the construction of the whole work, or separately, as bidders may elect.

Plans and specifications may be seen and all information in regard to the above work can be obtained at the office of the Superintendent of Water-Works, and all correspondence in relation to the same should be addressed to Edward Armstrong, Superintendent, City Hall, Allegheny, Pa.

A bond must accompany each proposal to the full amount of the bid, with sufficient sureties for the faithful performance of the contract.

The right is reserved by the Committee on Water to accept or reject bids for the whole or any part of the above work.

JAMES BROWN,
33-6t Comptroller.

## Water-Works and Electric Light.

**Special Council Proceedings.**

Whereas, a petition largely signed by the tax payers and business men of the city of Canton, South Dakota, has been presented to the council asking for water-works and that an electric light plant be put in.

Therefore, be it resolved by the city council in adjourned session assembled, that the city will contract with any person or company for water and a sufficient number of hydrants to afford adequate fire protection, and for a sufficient number of electric lights to properly light the city, and to pay annual rental therefor sufficient to warrant the investment of the capital necessary to put in said plant.

Further, that it is the sense of the council that steps be at once taken to advertise for parties to take hold of the enterprise and invite bids and plans and specifications to that end.

Passed and adopted by an unanimous vote of the aldermen present, Sept. 3, 1890.

Attest J. M. ZELLER, Mayor.
O. T. OLEGAARD, City Clerk. 37-2t

## Artesian Well.

Sealed proposals will be received by the undersigned at the City Hall, Galveston, Texas up to 12 o'clock, noon, of Thursday, Sept. 25, A. D., 1890, for the boring of an artesian well, in the City of Galveston, to a depth of 3,000 ft., unless satisfactory water is procured at a lesser depth. Bidders to give price per foot for finishing with 6-in., 8-in., 10-in. and 12-in. pipe respectively. The right to reject any or all bids is reserved. THOS. W. JACKSON,
35-3t Chairman of Special Committee.

# "THE WELLS LIGHT"

WALLWORK & WELLS' PATENTS. (Registered Title.)

USES KEROSENE OIL.

Obtainable Everywhere.

ESPECIALLY ADAPTED

—FOR—

## CONTRACTORS' NIGHT-WORK.

800 and 2,000 CANDLE POWER

REQUIRES NO ENGINE OR AIR COMPRESSOR to drive it as "others do."

(Copy.)

SAVANNAH, AMERICUS & MONTGOMERY RAILWAY.
OFFICE OF THE CHIEF ENGINEER,
AMERICUS, Ga., Aug. 8, 1890.
R. E. HARDAWAY, Chief Engineer.

*Messrs. Keegan & Halpin, 46 Washington Street, New York City:*

DEAR SIRS: I used four of your lights for steam shovel work at night some time since and they gave entire satisfaction.

Yours very truly,
B. E. HARDAWAY, C.E.

(Copy.)

WEST VIRGINIA IMPROVEMENT CO.
WESTON, W. Va., June 24, 1890.

*Messrs. Keegan & Halpin, 46 Washington Street, New York:*

GENTLEMEN: Replying to your favor of 21st inst., the light you sent us has thus far given satisfaction, and I can see no chance for improvement in it.

Yours truly,
J. A. FICKINGER, Ch. Eng.

WRITE FOR CIRCULAR.

THE "WELLS LIGHTS"

Are in use on the following Railroads:

Pennsylvania,
Lehigh Valley,
Erie,
West Shore,
Del., Lack. & West.,
Norfolk & Western,
Atlantic Coast Line,
N. Y., Prov. & Bost.,
W. N. Y. & Penn.,
Michigan Central,
Union Pacific,
Southern Pacific,
And **40** others.

ALSO USED BY

Moffett, Hodgins & Clarke;
Washburne, Shaler & Washburne;
Carkin, Stickney & Crane;
C. H. & F. T. Dunbar;
Ryan & McDonald;
Prentice Brown Stone Co.;
Drake & Stratton;
Union Bridge Co.;
Berlin Bridge Co.,
And many others.

NEW HAND PATTERN WELLS LIGHT.
500 Candles, ½ gall. per hour.

# KEEGAN & HALPIN

44 and 46 WASHINGTON STREET NEW YORK.


## SITUATIONS VACANT.

**WANTED.**—A college educated draughtsman with experience in designing and building automatic compound steam engines, vertical and horizontal, can find employment with a large engineering establishment in Pennsylvania. Address M. F. S., Engineering News. 37-2t

**WANTED.**—A surveyor to take charge of party in city and country work. Salary $80 a month. Also a transitman and chainman. Address, stating qualifications, CIVIL ENGINEER, care of Engineering News. 37-2t

**WANTED.**—An experienced draughtsman to do general railroad work in a civil engineer's office. Permanent employment for a good man. State age, experience, salary and give references. Address A. LEE, 505 Washington Street, Wilmington, Del. 37-2t

**WANTED.**—One or two draughtsmen, thoroughly competent for work on designs of canal locks, lock gates and their accessories. Must also be familiar with iron construction, and be competent computers. They are to go to Greytown, Nicaragua, under contract for one year. Passage out and back paid and subsistence furnished; also medical attendance and medicines free, in case of sickness. State experience had by applicants, and give testimonials and references. Address Nicaragua Canal Construction Co., 44 Wall Street, New York, N. Y. 37-3t

**WANTED.**—Experienced steam pump salesman, BUFFALO STEAM PUMP CO., Buffalo, N. Y. 38-1t

**WANTED.**—A bridge draftsman, must have had at least a year's experience at work in this country. Apply to PENN BRIDGE CO., Beaver Falls, Pa. 38-2t

## MISCELLANEOUS.

**WANTED.**—G. J. BAER, Paving Contractor, of Kansas City, Mo., writes from Key West, Fla.: "I want prices on about 5,000 lineal feet 4-in. curbing both on 14 in. and 16 in. wide, lengths not less than 4 ft. Price to be at wharf in Key West, Fla." Address care of "The New Russell Hotel."

**WANTED.**—Purchaser for file of ENGINEERING NEWS to Jan. 1, 1890. Vol. 1 and 2, bound in paper, vols. 4, 5, 6, 7, 8 and 9 half leather, balance in numbers. Price $50. SAMUEL CRAIG, Wapakoneta, O. 38-1t

**WANTED.**—W. E. Somerville, Emmorton, P. O., Harford Co., Md., wants addresses of engineering schools, preferably of Maryland or Pennsylvania. Address him direct.

## For Sale---Water-Works.

Located in Central New York, in a fine village of about 2,000 inhabitants. Supply from springs by gravity; everything first class and doing profitable business. Address
WATER-WORKS,
38-4t care of ENGINEERING NEWS.

## FOR SALE.

TEMPLE TRANSIT, reading 20" with full attachments. For particulars, address H. E. FLINT, City Engineer's Office, Springfield, Mass. 38-1t

## New Water-Works, Atlanta, Ga.

Sealed proposals will be received at the Mayor's office in the city of Atlanta, Ga., until 12 o'clock meridian, on the 1st day of October, 1890, for furnishing material and constructing new water-works, approximately as follows:

One horizontal pumping engine, boilers, etc., with capacity of pumping 10 million gallons in 24 hours against a head of 235 feet.

One horizontal pumping engine, boilers, etc., with capacity of pumping 6 million gallons in 24 hours, against a head of 350 feet.

One filter plant of a capacity of filtering by gravity under a head of 20 feet, 3 million gallons in 24 hours.

Two engine houses and 2 smoke stacks.

One reservoir—69,000 cubic yards of earth excavation, 1,000 yards rock excavation, 10,000 brick laid, 50 cubic yards concrete.

One clear water basin—3,500 cubic yards earth excavation, 500 cubic yards of rock excavation, 450,000 brick laid, 400 square feet concrete.

Pumping well and intake—3,000 cubic yards of earth excavation, 1,000 cubic yards rock excavation, 200,000 brick laid and 100 cubic yards concrete.

Cast iron pipe and specials—
600 lineal feet of 36-inch pipe.
28,000 lineal feet of 30-inch pipe.
7,500 lineal feet of 20-inch pipe
Valves, tees, crosses, valve boxes, etc.

Two pumping stations, consisting of 2 engine and 2 boiler rooms, one pumping well, one clear water basin and two brick chimneys.

Pipe laying—600 feet of 36-inch pipe, 28,000 feet of 30-inch pipe, 7,500 feet of 20-inch pipe, including valves, valve boxes and specials.

The above quantities and dimensions are to be considered approximate only, the committee reserving the right to increase or diminish as they may elect after receiving bids. Bids will be received for the whole or any particular branch or sub-division of the work.

Specifications and general plans can be seen at the office of the City Engineer or Superintendent of Water-works, Atlanta, Ga.

A certified check for $1,000 must accompany each bid, payable to John T. Glenn, Mayor, to be forfeited in the event of award and a failure to contract within 10 days. The right is reserved to reject any or all bids.

JNO. T. GLENN, Mayor.
R. M. CLAYTON, City Engr.
WM. G. RICHARDS, Supt. W. Wks.
38-4t

50 Cts. **WANTS.** 50 Cts

**Cards of not more than one-half inch will be inserted in this column one time for 50 cents.**

## SITUATIONS WANTED.

**WANTED.**—A young engineer, who can give good references, desires a place as transit observer or leveler with a corps on preliminary survey or location. Address "PERRY," care Engineering News. 35-4t

**WANTED.**—An engineer who expects soon to finish his present engagement desires position on location, construction or maintenance of way. Twenty years experience; 40 years old. Address C. E., Engineering News. 36—

**WANTED.**—Position as instrument man, resident engineer on railway construction, or assistant to some city engineer, by young engineer of two years' practical experience in general engineering, but chiefly in railroad work. Address B., care Engineering News. 36-3t

**WANTED.**—A graduate in civil engineering wishes permanent position in any department of civil engineering. Address F. G. DODD, Nutley, N. J. 36-3t

**WANTED.**—An engineer of 20 years' practice experience on railroads in many States of the Union is open to an engagement. Will accept a position on location, construction, maintenance of way, or with a good contracting firm. Have had much experience in both location and heavy construction. Have instruments of my own. Permanent position more an object than salary. Best of references can be given. Will be glad to confer with parties needing the services of an engineer. Address CIVIL ENGINEER, Box 22, Charlestown, Jefferson Co., W. Va. 36-4t

**WANTED.**—A civil engineer with several years' experience in the construction of bridges, cable roads, city and hydraulic engineering, is now open for engagement. Have a good outfit. Please address JAMES KELLEY, South Syracuse, N. Y. 37-1t

**WANTED.**—An experienced bridge engineer desires an engagement with a railroad company. Address "Bridge," care Engineering News. 37-2

**WANTED.**—A graduated civil engineer desires a position as assistant engineer or assistant superintendent with some manufacturing concern in or near New York. Railway equipment line preferred. Has had two years' experience in this line. G., care of Engineering News. 37-3t

**WANTED.**—A young graduate in civil engineering desires a position as draughtsman. One year's experience in field and office. Address "S. of M." care Engineering News. 38-1t

**WANTED.**—A graduate, Civil Engineer and Architect, German, of 20 years' experience (of which nine years has been in America) of railroad location and construction; also in stone and iron bridges and trestles, and buildings; a first-class draughtsman, good letterer; desires position as division engineer, or take charge of party or location. First-class references. Address RAILROAD ENGINEER, care of Engineering News. 38-2t

**WANTED.**—Engineer, Draughtsman and Surveyor desires a change of position (reasons given). Have had charge of a field and office force. Experience on railroad, city, sewer, hydraulic engineering, cable road work in detail, steam boiler and engine plant and structural iron design. Surveying, topographical and mechanical draughting. Particulars given. Will accept only such position as can fill satisfactory. Address F., 208 East 118th street, New York City. 38-3t

**WANTED.**—To CAPITALISTS AND INVESTORS—A civil engineer of experience in the location, construction, equipment, and operation of railways wants an engagement with capitalists in developing NEW RAILWAY LINES. Will furnish first-class references. Address R. W., care of Engineering News. 38-3t

**WANTED.**—To sell back volumes of London Engineering. Have also number of odd numbers, loose, and several indexes for sale. State dates of what you need and price you will pay. Address F. A. P., Engineering News, New York.

## Wanted---A Railroad Man.

A prominent manufacturing company desires to secure the services of a thorough business man who is now or has been identified in an official capacity with some good road. A man having filled the position of General Superintendent or General Manager preferred. To a satisfactory party with some means an official position will be given. Address W. G. & A. T. Ewing, Room 38, Montauk Block, Chicago. 38-4t

## PORTLAND CEMENT PIPE CO.,

MANUFACTURERS OF

SEWER PIPE,
PORTLAND CEMENT.

PORTLAND, MAINE.

Catalogue Mailed on Application.

PROPOSALS FOR LOCK CONSTRUCTION.

Engineer's Office, U. S. Army, Nashville, Tennessee, August 18, 1890. Sealed proposals, in triplicate, will be received at this office until 3 P. M. Tuesday, September 23, 1890, for part construction and completion of Lock No. 1, Cumberland River, near Nashville, Tennessee. Bidders are invited to be present at opening of the bids. The United States reserves the right to reject any and all proposals. The attention of bidders is invited to the acts of Congress, approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Specifications and blank forms for proposals will be furnished on application at this office. J. W. BARLOW, Lieut. Col. of Engineers. 35-4t

Engr. in Charge, | 39-9t. | Knoxville, Tenn. | 38-3t | 35-6t | Chairman of Special Committee.